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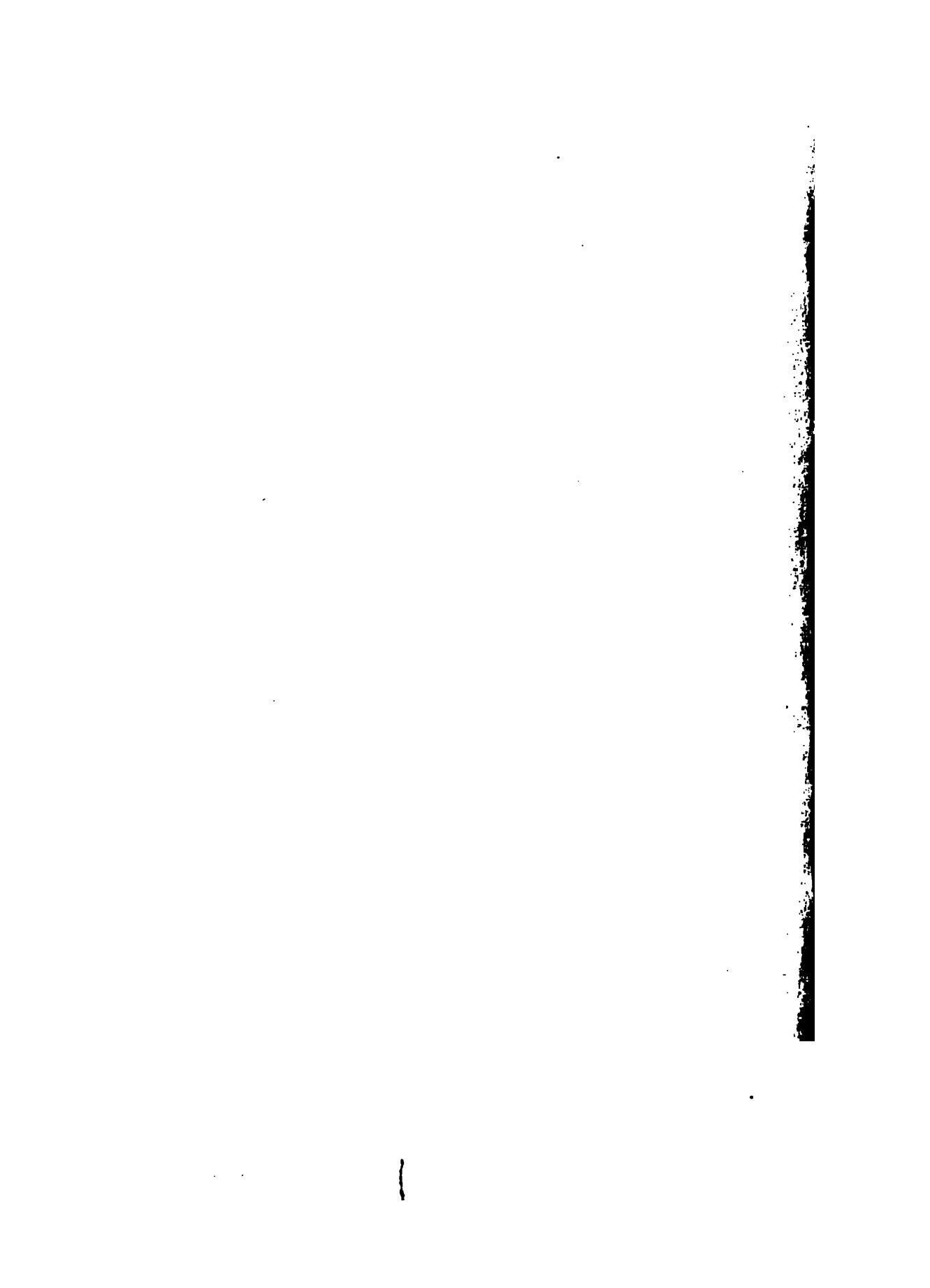
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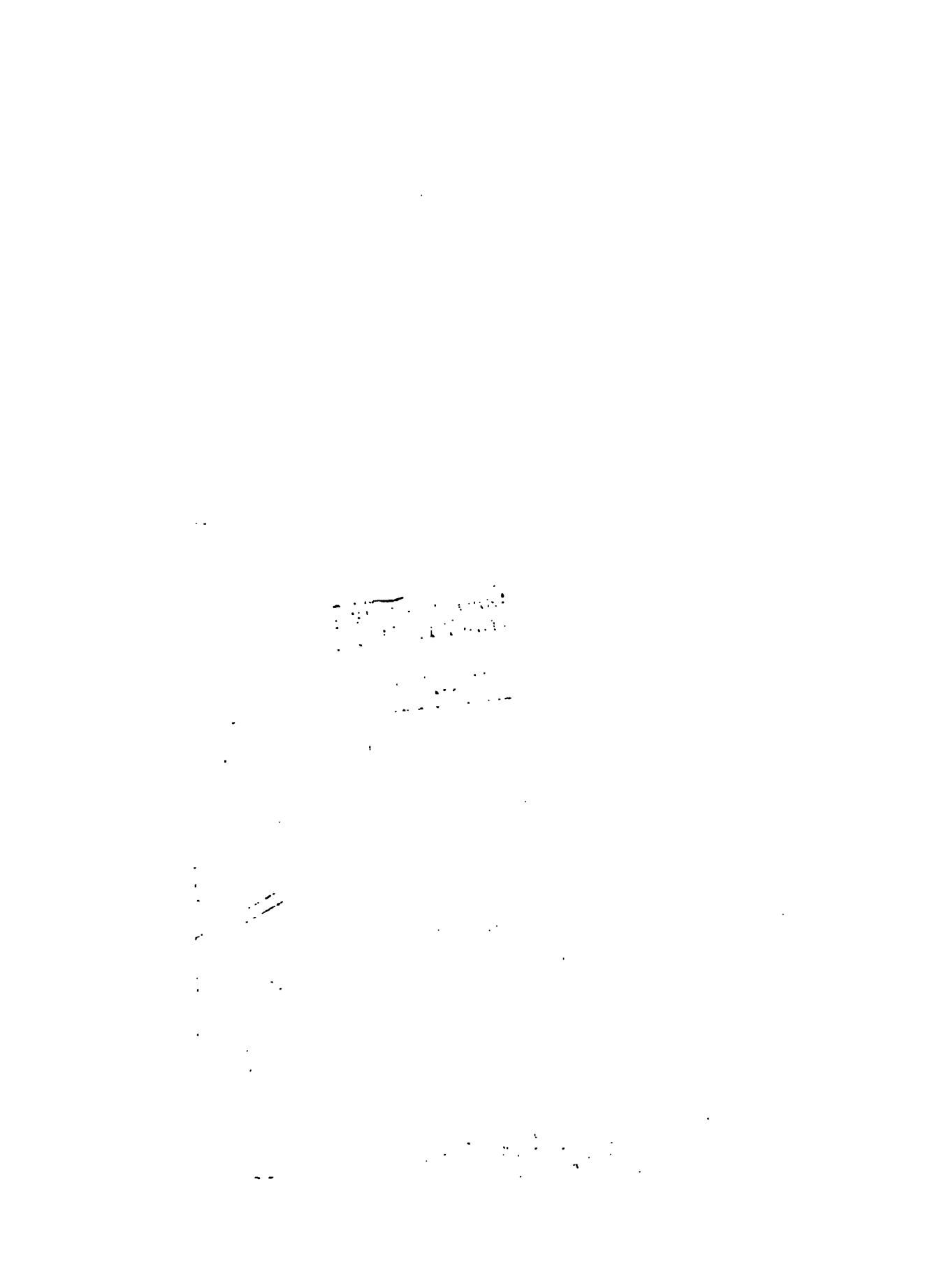




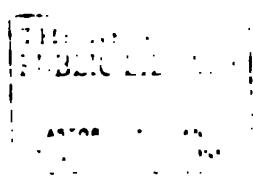


LA
Los Angeles, Cal.
Watts and Pershing
Tunnels











BUENA VISTA RESERVOIR.

Los Angeles, City Water and Power Dept.

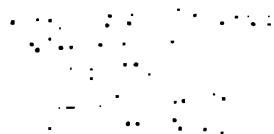
ANNUAL REPORT

OF THE

Board of Water Commissioners

OF THE

DOMESTIC WATER WORKS SYSTEM OF THE CITY OF LOS ANGELES



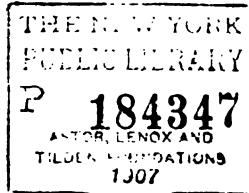
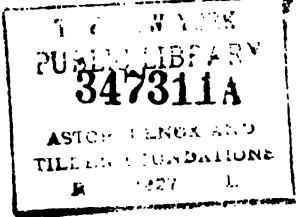
FOR THE FISCAL YEAR ENDING

NOVEMBER 30, 1902

LOS ANGELES, CAL.

PRESS OF THE OUT WEST COMPANY

1902



BOARD OF COMMISSIONERS

♦ ♦

HERMAN SILVER, PRESIDENT

H. T. LEE

J. M. ELLIOTT

CHAS. H. TOLL

E. W. KING

L. A. GRANT

J. C. DRAKE

W. A. GIBSON

Report of Board of Water Commissioners.

To the Honorable City Council of Los Angeles.

GENTLEMEN: Under the provisions of an Ordinance adopted by your Honorable Body February 5th, 1902, and approved by the Mayor February 6th, 1902, the Board of Water Commissioners organized February 13th, 1902, electing Hon. Herman Silver its President, and pursuant to Section 18 of said Ordinance, the Board now respectfully submits its report, covering the period from February 13th, 1902, to December 1st, 1902, being the active portion of the first fiscal year of the Domestic Water Works System of the City.

In presenting this their first annual report since the taking over by the City of the management and control of its waters and its system of municipal water works, your Commissioners deem it not inappropriate to allude briefly to the origin and history of the city's rights in the waters of the river Los Angeles.

Pueblo Reina de Los Angeles, with one or two others, was a "pure" Pueblo, founded in full compliance with the Spanish laws and customs, in contradistinction to the "presidial" Pueblos, which grew up under the protection of the military Presidios.

While there was no specific grant made to the Pueblo of the waters of the Peninsula, as the river was then called, it was vested as a pure Pueblo, under the royal laws and customs made and established for the colonies, with title to the waters of the river to be enjoyed by its inhabitants for irrigation and domestic purposes in common use, as was also the case in regard to the woodland and common pasture lands.

The Spanish and Mexican archives abound in interesting episodes, showing how highly the authorities and citizens of the Pueblo prized their water rights, how zealously they guarded them against all adverse claims, even those of clanging missions, and how they instantly and valiantly defended them against unfriendly acts; and we, their successors, in this precious and unique heritage, will do well to emulate their aggressive vigilance.

The City of Los Angeles, as the successor to the Pueblo, became vested, on its organization in 1850, with all the rights of the Pueblo, including its right to the waters of the river.

While it is apparent that the Pueblo claimed and sought a right of ownership to absolute and exclusive title to and control of all the waters of the river, the Supreme Court has disallowed that absolute and exclusive claim, nevertheless, in various decisions, defined and extended the rights of municipal use to and control over the waters of the river, which, if zealously protected and maintained, sufficiently protect the city. It is held that the city has the paramount right to so much of the water flowing in the river at any point from its source or sources to the southern boundary of the city as it may require for municipal uses and for the use of its inhabitants, that thus

right inheres not only in the surface stream but in the stream as it flows below the surface, and in all subterranean waters which supply the surface or underground stream; that this right is not limited to the territory covered by the original Pueblo, but attaches to all additional territory from time to time brought within the city's limits; nor is this right limited to the original uses of the Pueblo and its inhabitants, which were practically confined to absolute necessities, but expands so as to take in all uses, individual and municipal, naturally arising from the growth of the city and from the demands of an ever advancing civilization.

The earlier use of the waters was naturally chiefly for irrigation, and the domestic supply was largely obtained from the zanjas or irrigating ditches. Gradually a crude system of wooden and iron pipes for domestic supply was evolved, in which condition, in the year 1868, the water works, such as they were, were taken over by the predecessors of the Los Angeles City Water Company under the thirty-year contract whose term expired on the 24th day of July, 1898.

When this contract went into effect, the population of the city was about 5000, and for the first year the gross earnings of the company did not exceed \$20,000; when the contract expired, the population of the city was over 100,000, and the gross earnings of the company about \$425,000 per annum. The water company took over a primitive system consisting of about two miles of wooden pipe, about one mile of iron pipe, and an antiquated water wheel for the raising of the water from the river; it turned over to the city finally a system composed of over 325 miles of iron pipe, ranging in size from forty-eight inches to two inches, with many miles of ditches, tunnels, infiltration galleries, reservoirs and pumping plants.

It is not necessary, nor is it fitting that this report should attempt to deal with the merits of the controversy between the water company and the city, which arose upon the expiration of the term of the contract and was carried on for over three years, in many actions, in all the courts having jurisdiction, and involving many difficult questions of law and equity. This controversy has been terminated by the taking over of the works by the City at the agreed price of \$2,000,000, and the settlement was overwhelmingly approved by the citizens, as shown by their vote of over five to one authorizing the issue of the water bonds.

It is well, however, to seriously consider and take to heart the unmistakable lesson taught by the whole history of this transaction, beginning with the execution of the contract in 1868 and ending with the payment of the price for the works in 1901; and that lesson is the unwisdom and the danger of yielding up for any consideration or to any person the municipal control of the waters which the city owns and has always owned.

It is not the economic theory of municipal ownership and administration of public utilities which concerns us; we are confronted with a condition and not a theory. The city owns its waters, and our experience should convince us of this generation of the far-sighted wisdom of our Spanish and Mexican predecessors in holding on to their rights in the waters of the river of Los Angeles with a grip of iron.

In the transition of management from a private corporation to a Municipal Board, we were impressed with the necessity of conservative action, and our

effort has been to retain those features of the system which had proved themselves worthy by long time and experience, and to be slow and cautious in the matter of new departures.

The period of comparative inaction in construction work that preceded the taking over of the water works by the City, the acceleration of growth that began about a year previous to the transfer and has continued since with ever-increasing strides, and the experienced drought for a number of years past, has put the management to its utmost efforts to keep pace with the demands that pressed upon it, not alone for further extension of the system, but by increase in the demand in areas that were already thought to be well provided, and the same reasons which necessarily retarded the action of the Board in enlarging the system for distributing the water to consumers also restrained the work of further development for the increase of the water supply.

It was assumed that by maintaining the rates at a figure which would assure the return of an income equal to that being earned by the system when the City came into possession, no trouble would be experienced to meet the needs of its patrons, but the almost phenomenal growth of the City which is now being experienced, as well as the degree of impatience evinced in some quarters, already well served, to have larger mains laid, has taxed the available funds, as well as the construction force of the Department, to the limit.

The large proportion of the territory now being built on is in outlying tracts, requiring that extensions be made to the already great mileage of the pipe line. This puts a great and unexpected burden on our finances and severely retards us in the application of our efforts to the procurement of a more abundant water supply, either by its conservation in the winter months or otherwise.

We have managed, however, to continue the work of development in the Buena Vista Tunnel, and will undoubtedly be able to obtain additional water from that source. Bids for the machinery to raise the water from this tunnel are now being advertised for, and it will probably be installed and ready for operation by May next.

CIVIL SERVICE.

The Commission, being in full accord with the provision in the Ordinance relative to the Civil Service, unanimously adopted the Civil Service principle, in so far as it could be followed with due regard for the best interest of the service, and having taken into consideration the reliability, efficiency, and the experience acquired by reason of long service by those in the employ of the former Los Angeles City Water Company, it was deemed advisable to retain them in the service of the City, and few changes were made in the technical and clerical departments.

Mr. William Mulholland, the former Engineer, was retained in the capacity of Superintendent, and Mr. Fred Eaton was employed as Consulting Engineer for a period of three months. The engineering and general superintendence being under the direction of Mr. William Mulholland, other necessary changes were mostly made by the promotion of those in the service who have proved their capacity and efficiency. In all changes and new appointments the best interest of the Department alone has been considered.

*ANNUAL REPORT OF THE
COLLECTORS.*

Section 5 of the Ordinance for the operation and maintenance of this Department provides:

"The Board shall, within nine months from their qualification, provide for the collection of water rates, to the end that the same be payable at the office of said Board."

A proposition to dispense with the Collectors, and to delegate to the Tax Collector's office the collection of water rates, was made in a special message of the Hon. P. W. Powers, acting Mayor of the City, submitted to the Council May 6th, 1902, and by the Council referred to this Board. The proposed measure was thoroughly canvassed in a report of a Special Committee of this Board, and unanimously adopted by the Board, and we take the liberty of quoting the conclusions reached by the Committee.

"It is the deliberate conviction of your committee that it would be unwise to attempt any radical change until the plans now under advisement, and in part already commenced, for the further development of the waters of the river, the establishment of additional storage reservoirs for the conservation of the winter flow, and the more efficient and equitable distribution and delivery of the waters, are substantially carried out and completed. When that is accomplished, a material reduction of water rates can be made, and then, in the judgment of the committee, will be the opportune time to consider and institute radical changes in administration.

"If we are to be governed by the experience of others, it would seem that the changes most to be desired in our system are the making the bills payable less frequently, and their payment at the office of the Department; on these two points the reports from the thirty cities whose reports were examined by the Committee are overwhelmingly favorable. To these we may add the more general use of meters, a reform to which the Board is now giving its earnest attention.

"In conclusion, your committee recommend no immediate change in the methods of the office, excepting the gradual increase in the use of the meter service."

The full report of the Committee has been submitted to your Honorable Body.

At any rate, before Collectors could be dismissed, it is necessary to provide a central office, accessible and convenient for the rate payers.

METERS.

The impending shortage of the water supply last summer was a subject of the deepest concern. This problem was, however, most fortunately solved by the perfectly equitable and rational method of applying meters. The Board met with much unreasonable opposition in the application of this measure, and it is surprising how forgetful people are of the theory on which all assessments are made for the maintenance of government for all manner of public service. The object is to so levy on each individual as to have him pay for the share of those benefits he receives. This is precisely what a meter is intended to accomplish in the case of that greatest of public utilities, a water supply.

Measured by its results, the meter system, even on the limited scale to which it has been tried, has proved an unqualified success, its influence having been extended far beyond the restraint it put on the services to which meters were applied, by reason of the agitation their use invoked, calling attention in an effective manner to the extravagant use, and in many cases the most reckless waste of water. The effect of the education cannot be over-estimated. The application of the meters has caused a saving of nearly three million gallons of water daily, an amount which, if figured at the rate of even the common price of irrigating water, viz., \$1000 per inch for a permanent right, would amount to \$231,000.

When we also consider the fact that all the expense that has been incurred in collecting, storing and delivering this water to the consumers before it is wasted, and the consequent limiting effect it has on the capacity of the plant, in addition to the loss of the water itself, it is entirely within the bounds of reason to appraise this saved water at one million dollars.

The introduction of the meter has enabled the Board to realize its cherished hope of reducing the water rates further, and it felt warranted in reducing ten per cent. from the flat rates and fifty per cent. from the former meter rates.

We quote a few excerpts from published reports of various cities. Even with cities which have an unlimited supply of water from which to draw, it is considered a measure of expediency to enforce economy of consumption through meters rather than to extend the works.

The Board of Water Commissioners of the City of Detroit, Michigan, in its report of June 30th, 1901, says:

"The daily per capita rapidly decreases in proportion to the use of meters. After careful investigation, the City of Milwaukee has adopted the general use of meters, and the City of Cleveland has also recently adopted the meter system. Many cities are looking in this direction rather than to the extension of plants to meet increased demands. There is no desire on the part of the Board to restrict in any way the most liberal use of water for all legitimate purposes, but there is no necessity that the people should be compelled to pay for waste that is a benefit to no one."

The Minneapolis report for 1901 says:

"Notwithstanding the excessive hot and dry season, the pumping of water has decreased The per capita has steadily decreased as follows: For 1890, 64 gallons; 1900, 63 gallons; and for 1901, 59 gallons. This can be attributed to different causes Secondly, the installation of water meters and the house-to-house inspection attempted. The waste of water in buildings is great, and I believe only the meter system will remedy it."

In St. Paul, the report of the Board of Water Commissioners, February 1st, 1902, says:

"The number of meter accounts have increased during the last ten years from 580 to 5593."

The St. Louis report for April, 1901, says:

"The universal introduction of the meter system will cause a reduction in the waste of water, enabling the power companies to supply the city for a much longer period of years."

The report of the Water Board of Cambridge, Massachusetts, for 1901 says:

"The total number of meters now in use is 1898, of which 1070 were set this year, in accordance with the vote of the City Council appropriating the sum of \$10,000 for the purpose of extension of the meter system. The Board earnestly recommend the appropriation of a similar or larger sum for the ensuing year, for the reasons already given in the last annual report. Many water-takers prefer to have water meters attached to their supplies, and have petitioned the Board to that effect, and, so far as they were able, the Board have invariably granted the requests of these water-takers. Unless, however, a suitable appropriation shall be made, the Board will be compelled to disappoint a great many applicants, as they have in several cases been obliged to do heretofore, for want of a sufficient number of meters. The system seems to be growing in favor with the water-takers, especially since the City Council, on the recommendation of the Board, during the past year reduced the minimum rate for metered water to five dollars, thus making it possible for economical consumers of water to make a considerable saving in the amount of their water bills, which they could not do under the former minimum rate of fifteen dollars."

"We meet evidences on every hand that the meter system is constantly growing in popularity. In view of the fact that the general use of meters is recommended by the Chief Engineer of the Metropolitan Board, and that the Water Boards of the different cities of the Commonwealth who have adopted a meter system, in whole or in part, unanimously favor that method of distributing water, it is probable that, within a few years, every city in the Commonwealth, including those embraced in the Metropolitan district, will have adopted the system, either as a matter of necessity, to prevent waste, or as a matter of choice, in order to distribute equitably among water-takers the burden of the expense of maintenance."

The Board feels gratified to state that the opposition to meters has nearly subsided, and that the system is accepted by most of our citizens with grace, and it is to be hoped that the consumers will receive their reward in a much improved service, and a further reduction of water rates as soon as the financial condition will permit.

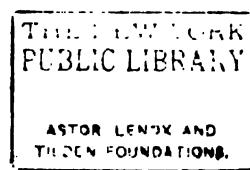
With the approach of winter and the consequent decrease in the demand for water, we shall manage to get along for the next six months without inconvenience to the inhabitants of districts that feel the effects of an inadequate pipe capacity, and it is expected that with the completion of the work now laid out and provided for in the recent contracts let, the work of fortifying the system with large mains will have progressed so far by next summer as to provide an ample supply even in the remotest districts.

With this accomplished, our successors can turn their attention to the carrying out of some of the recommendations of the recently submitted plans for the comprehensive improvement of the works, especially that of the construction of the Main Supply Conduit and Ivanhoe Storage Reservoir.

The re-districting of the city with regard to the elevation from which the water is to be supplied to each section, as outlined in the map marked in colored zones and presented in the general plans for the improvement of the works, will be accomplished early in the coming spring, and will result in a



HIGH-GRAVITY RESERVOIR.



marked improvement in the efficiency of the whole pipe system both for domestic and fire purposes. It will also be the indirect means of saving much water now being wasted in the older portions of the city, due to defective old-style plumbing that will probably fail under the increased pressure and compel careless property owners to replace it with modern appliances.

ELECTROLYSIS.

The subject of the rapid destruction of the pipes of the system in districts adjacent to the power stations of the electric railways, by electrolytic decomposition of the metal, was investigated by the Board, and as there appeared to be no reason why the parties at fault should not apply remedies which are known to be effective wherever tried, their attention was called to the matter, with the result that one of the companies operating here has employed an expert to determine the volume and voltage of the return currents following the pipe lines, to the end that proper steps should be taken to protect them from damage.

An active campaign against the rather startling danger to metal substructures presented by this insidious enemy was begun a few years ago in many Eastern cities, and the decisions, where the matter has been taken into Court, so far have been universally against the parties who permit the residual currents from their plants to follow the gas and water pipes in returning to the generating stations.

Ordinances have been passed in many cities having electric traction, both in this country and Europe, prescribing methods that must be followed to prevent this evil.

Its nature and the remedies for its prevention are well known, and it is to be hoped that there will be no necessity to invoke judicial aid to protect the City from the great loss caused by the electrolysis.

We herewith submit the able report of Superintendent William Mulholland, a careful perusal of which is especially invited. We also submit the Auditor's report, containing an itemized statement of the financial operation, and a summary of all receipts and disbursements from the time of the taking over of the plant by the City.

In conclusion, the Board tenders its thanks to the Mayor and members of the City Council for courtesies extended since the organization of the Board.

We cheerfully give public acknowledgment of the valuable and most efficient service rendered the City and the Board by the Superintendent, Mr. William Mulholland. We also recognize with thanks the efficient and faithful service rendered by the Auditor, officers and employees of the several departments.

HERMAN SILVER, President,

H. T. LEE,

J. M. ELLIOTT,

CHAS. H. TOLL,

F. W. KING,

L. A. GRANT,

J. C. DRAKE

Board of Commissioners.

Auditor's Report.

LOS ANGELES, CAL., December 1, 1902.

To the Honorable Board of Water Commissioners,
Of the City of Los Angeles.

GENTLEMEN:—

I herewith submit to you a statement of the financial transactions of the Domestic Water Works Department of the City, from February 4th to November 30th, 1902, inclusive:

There has been collected from all sources \$456,317.83, and \$237,924.19 disbursed; \$89,453.07 transferred by the City to Interest and Sinking Fund, and \$6,785.70 the first three deposits by the Cashier which went into the Municipal Water Works Fund (as the ordinance creating the other funds was not passed until after February 7th), leaving the following balances in the Water Department funds:

Water Operating Fund.....	\$140,460.40
Water Emergency Fund.....	975.22
Water Deposit Trust Fund	718.65
Total	\$142,154.27

There are outstanding contracts amounting to \$104,140.30, and \$4,206.65 due on requisitions in the hands of the Supply Committees of the Board and City Council for sundry supplies.

There were 23,119 services when the City took possession.

There have been 2,585 services sold, 373 acquired by purchase of the Highlands system, and 105 by purchase of the O'Dea and Kysor systems, making a total of 26,182.

The Department furnishes free water to the City for street sprinkling, sewer flushing, schools, fire purposes, city buildings, and for parks, except in a few cases where the parks pay a nominal rate.

The Department also furnishes about 40 families in destitute circumstances with free water, and to charitable Institutions a discount of 85 per cent is made.

In concluding this report I wish to thank your Honorable Body for your confidence and support.

Respectfully submitted,

L. M. ANDERSON,

Auditor.

DETAILED STATEMENT OF RECEIPTS AND DISBURSEMENTS.

RECEIPTS.

Year	February	March	April	May	June	July	August	September	October	November	Totals
Water Rates	\$36,109.52	\$41,694.67	\$42,105.15	\$42,746.97	\$43,313.78	\$43,257.70	\$43,249.92	\$44,924.66	\$41,462.86	\$39,817.27	\$419,032.61
Permits	443.20	548.65	917.40	742.53	551.70	791.50	772.70	934.14	863.85	1,031.10	7,906.71
Services	1,041.00	2,179.00	2,465.25	2,293.00	2,572.00	2,146.00	2,843.00	3,618.00	4,072.00	3,314.00	27,293.25
Rent	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	N.(N)	80.00
Meters											65.00
Sundries	1.40	17.50	9.85	14.34	104.64	71.90	114.85	134.90	275.92	97.15	1,004.61
Deposits		749.65	30.00	30.00	.....	27.00	10.00	20.00	.....	22.00	848.65
	\$ 442.25	\$ 45,197.47	\$ 45,685.55	\$ 45,943.80	\$ 46,044.16	\$ 46,378.19	\$ 47,029.47	\$ 49,639.74	\$ 47,182.65	\$ 44,354.52	\$ 456,317.83

DISBURSEMENTS.

Construction	\$ 1,718.10	\$ 2,444.11	\$ 1,117.68	\$ 1,092.84	\$ 0,351.24	\$10,916.08	\$13,404.26	\$39,483.46	\$30,795.13	38,445.68	\$151,428.69
Maintenance	132.12	1,120.46	211.83	204.46	273.38	417.68	305.39	341.63	254.85	277.62	3,529.82
Operating	1,088.47	3,818.03	2,757.00	4,307.97	4,461.97	5,155.48	5,185.02	4,852.29	5,486.90	5,174.18	44,378.80
Meters					3,929.38	295.77	10.56	1,211.20	9,020.05		14,466.96
Hoses and Wagons					291.00	255.00	.....	210.00	350.00		1,105.00
High Tides Reservoir						121.50	2,419.67	2,620.03	2,654.29		7,815.49
Infiltration Galleries	72.02	122.05	2,375.87	1,934.78	2,926.18	2,248.69	1,536.97	921.60	2,129.27	14,967.43	
Machinery	10.00	10.00	10.00	10.00	40.00	.....	10.00	10.00	10.00	10.00	102.00
Deposits											130.00
	\$ 4,030.15	\$ 41,164.64	\$ 4,048.65	\$ 10,771.54	\$ 20,249.75	\$ 20,000.11	\$ 21,365.42	\$ 30,085.22	\$ 349,470.31	\$ 48,823.29	\$ 237,924.19

There has been paid out for salaries (which is included in Construction and Operating Account) \$34,718.63.

L. M. ANDERSON, Auditor.

Superintendent's Report.

LOS ANGELES, CAL., Oct. 30th, 1902.

*To the Honorable,
Board of Water Commissioners,
Of the City of Los Angeles.*

GENTLEMEN:—

Pursuant to your request and instructions given to me at your meeting of February 13th, 1902, to prepare plans for the betterment of the Domestic Water Works of the City, I, in conjunction with Mr. Fred Eaton, C. E., whom you were kind enough to associate with me as Consulting Engineer in this important work, and Mr. Harry Stafford, City Engineer, proceeded to make a full and complete study of the requirements of the System and to devise plans on a scale of sufficient magnitude to provide for the delivery to the inhabitants of the City of all the water now flowing or that may in future be developed in the Los Angeles River water shed.

Owing to the pressing demands of other work the preparation of the report and plans here submitted were much delayed and both myself and the gentlemen associated with me feel much indebted to your Honorable Body for your considerate patience with their tardy production.

Most of the subjects treated will be found to have had previous consideration from your Honorable Body in the form of fragmentary reports submitted at various times during the past summer, and some of the recommendations are now in process of being carried out. They are included here, however, to the end that the report may embrace the entire subject in continuity.

With this brief statement I have the honor of presenting the joint product of our labors.

INTRODUCTORY.

The location of nearly every town of importance in the State of California South of San Francisco was originally determined by the selection of the old Mission Fathers, and it is interesting to note that in almost every instance the prime factor controlling such location was the availability of a reliable and abundant water supply. Indeed it would have been wholly at variance with the good sense of those learned and prudent men had they failed to notice the general aridity of the country, coming as they did from a country still more arid, and whose object was to gather about them for the purposes of evangelization aggregations of the primitive inhabitants of the country. This required that attention should be paid to the possibility of providing for their maintenance from the products of the soil, and well knowing that this was only possible where water could be obtained for irrigation the more important missions were established where water was most abundant.

The remains of the ditches and reservoirs, which attest the early efforts of these hardy and enterprising pioneers of civilization to establish irrigating works, are still visible about the various missions, and some of them are still in a fair state of preservation and show a high degree of engineering skill.

With the progress of civilization, first the Mission, then the Pueblo, and finally the advent of the American, the importance of the water supply was emphasized by the marked way in which the relative growth of each town was measured by the greater or less abundance of this life-giving element.

It may be inferred from the devout and fervent name given to Los Angeles, that those worthy men had attached due weight to the natural advantages in this and other respects possessed by this locality, and her subsequent growth into the beautiful and flourishing city she has now become does great credit to their judgment and foresight.

The old records and annals of the Pueblo and later of the City of Los Angeles bear ample evidence of the jealous care and attention given to the conservation and distribution of the water supply, as they teem with references to it and give many accounts of sturdy resistance by the authorities to its unauthorized use.

In later times, as in the past, there has been no single subject affecting the welfare of the City that has received more attention and study, both legal and scientific, than that of the Water Supply.

Through many bitterly contested lawsuits the City has fought to repel invasions of her water rights. Eminent lawyers have been engaged on both sides in those legal battles and skilled engineers have given thorough investigation to the source of the supply as well as to every natural or artificial influence that affects it, so that the result of all this labor has produced a compendium of facts that covers every phase of the subject that could possibly be gleaned either directly by observation or by theoretical inference.

WATER SHED.

A casual examination of the map hereto appended showing the water sheds of the Los Angeles and San Gabriel rivers, will show that while those two streams may not, strictly speaking, have their rise in the high range of the Sierra Madre mountains, they, at least as to the great bulk of their waters, have their origin there, for it is a well known fact based on years of careful observation that the rainfall on those steep and nearly impervious rocky slopes is much greater than that of the valleys.

The San Gabriel river is different from the Los Angeles in that it has a perennial flow in the mountain range from which it mainly originates, but in its lower reach where it flows through the Pasco Bartolo, a gap in the Puente hills, its volume is much more constant and less affected by season of drought, the reason for this being perfectly obvious with a little explanation of the geology of the region which it drains.

This map shows in addition to the high range of the Sierra Madre mountains a range of lesser mountains or hills running approximately parallel thereto and including between the two ranges an extensive area of valley. This interior valley is divided into two parts by a group of jumbled hills that occupies the space between the two ranges to the North and East of the City.

of Los Angeles. The Easterly division is known as the Upper San Gabriel valley and the Westerly division as the San Fernando valley, each named respectively from the missions established therein.

Geology of Water Shed.

During the geological era known as the Tertiary period this portion of the Pacific Coast was at least 1800 feet lower than it is now, and the sea beat against the slopes of the Sierra Madre mountains. The product of erosion from the mountains was carried into the sea and deposited in the form of sediments, the coarser materials remaining close in shore in roughly stratified beds of conglomerates and the coarser sandstones, while the finer material was conveyed out farther and deposited in more thinly bedded strata of finely grained sandstones, finally tapering to the clayey material which in settling to the bottom carried down with it the microscopic shells with which the waters of the ocean teem and forming the light-colored chalky shales which are today so conspicuous a feature in every hill-cut along the Southerly slopes of the hills in this city.

At the close of the Tertiary period the coast was raised by the titanic and mysterious work of nature to a height not less than 700 feet greater than it has at present, after which it slowly subsided, but with occasional long periods of rest, to its present level.

The first fact is shown by the presence of beds of marine marginal deposits containing fossils of molluscan and other marine animals high up on the flanks of the mountains and also by the composition of the stratified rocks in the outer range; and the second is conclusively shown by the borings for artesian wells six and seven hundred feet below sea level in the lower San Gabriel valley penetrating beds of lacustrine clays, and bog deposits containing well preserved roots of aquatic plants; and in one instance that came directly under the observation of the writer a great log was encountered at a depth of over 400 feet below the present level of the sea. It is also to be noted that all the water produced from these wells is fresh and derived from angular fresh water sands and gravels, showing that they were transported to their present position by water running at high velocity to the sea at a still lower level.

During the great crustal movements that accompanied these upheavals and subsidences it is probable that the folding took place that created the outer range of hills. We can even fix the order of these movements with greater definiteness from the fact that borings in the pass through which the San Gabriel has cut its way through those hills, viz., the Paso Bartolo, have been made over 200 feet below sea level without touching the scoured bed rock bottom of the ancient stream, so that the conclusion is warranted that the hills were formed or at least in process of formation before the period of subsidence, as this gap could not have been cut down so deep unless its lowest scour was above sea level.

Borings in the pass through which the Los Angeles river flows reached bed rock at a depth of 230 feet above sea level. This taken together with the fact that a much older series of rocks crops at the point where the Los Angeles cuts through the hills than that at which the San Gabriel has scoured its course would alone lead to the conclusion (the rock being equally soft) that the elevation and upheaval due to the process of folding was continued

to a later period in the case of the Los Angeles pass than that of the San Gabriel.

The confusing irregularity in the disturbances of the strata in the jumbled group of hills lying just North of this point, which shows much plicated folding, has had in all probability some connection with this unusual condition.

That this continued upward movement was only local is well proved by borings made several miles up the valley, two of which near West Glendale reached a depth of several feet below sea level without encountering bedrock; penetrating deep beds of clay containing fresh water fossils which at once suggests a dammed up condition of the neck of the valley below, during the period of their deposition, and the existence at this period of a lake in the valley extending from the narrows above the Buena Vista bridge to a distance of probably 8 or 10 miles up the valley. In other words, if all the loose alluvial detritus were removed from the lower San Fernando valley, down to bedrock, there would now exist a depression over 230 feet deep below the top of the bedrock underlying the river bed at the narrows.

Although the causes accounting for the existence of the outer range of hills were similar throughout their whole length, viz., the buckling up of an antecedent fold, it will be noticed that the West end of the range or that bounding the South side of the San Fernando is more mountainous and rugged than the East end. This is due to the fact that massive plutonic rock, mainly granite, was thrust up in the axis of the fold along this portion of the range, carrying up on its mighty back rocks of a greater age than the Tertiary, as witness the coarse sandstones at the summit of the Cahuenga Pass. Highly metamorphic slates and even eruptive rocks also occur in this range, and the red porphyry that was used in paving Third street came from it. The light chalky shales of the Tertiary period still stick to her Northernly flanks, however, showing that it is not always the harder rocks that resist weathering best.

From these and other geological observations, we conclude that both the San Fernando and upper San Gabriel valleys are valleys of contraction and not depressions cut out by water, as in the case of valleys of erosion.

All the borings in both valleys show that instead of being cut out, a filling up process started from the beginning of their existence and is hardly yet at an end.

Calling our attention now to the San Fernando Valley, we find that on the South side, the slopes of the hills are of shale which weathers slowly, and observation for years tells us that the rainfall is comparatively light on that side of the valley, also the preponderating mass of material comes in the hills from mountains with the heavier rainfall on the North side of the valley, tending to keep that side the highest. It follows also that when the canions are full, on the South side the floods are contemporaneous and greater on the North side, so that when these floods meet in the valley they are voluminous enough and have sufficient velocity to keep in suspension all the debris, thereby, and prevent its deposition in the valley, sweeping it right clear to the ocean and leaving only the coarser granite, sand and gravel behind.

It is true that beds of clay of considerable thickness are found by borings in the San Fernando Valley, but these are the product of depositions from well impounded water during periods of engorgement at its neck, and the

plicated folding of the rock system at that point bears some evidence that such engorgements may have frequently occurred even quite late in the Pleistocene period.

In this manner the valley has been filled up with a porous mass of material having such enormous capacity for storing water that even with an absolute cessation of rain for several years it would not wholly drain out.

The water thus stored in this desert-appearing valley supplies about all the water consumed by the inhabitants of the City of Los Angeles, and is the contribution of over 450 miles of watershed.

If one were permitted in the cold pages of an engineering report to moralize on the inscrutable workings of nature for man's benefit he would have here a subject from which could be deduced much food for serious reflection.

One can't help wondering if the simple, pious Missionary Fathers had in mind the beneficent gifts of the old hoary-headed mountain when they named it Sierra Madre. First of all she gave from her huge bulk the material that formed for the most part the outer range of hills to check the direct seaward flow of water, and after they assumed their present form she kindly contributed the debris to fill the valley, all the while sending heavenward her cold and beetling crags to condense into snow and rain the over-scant supply of clouds rude Boreas blows to this sunlit land.

Let us bow in kindly gratitude to the good Mother Mountain.

METEOROLOGICAL.

The records of the rainfall of this portion of the State were not officially begun until 1877, but the individual memoranda kept by a few careful and reliable men such as the late Charles Ducommun, extend much farther back. These records relate only to the rainfall of Los Angeles city and would seem to indicate an average precipitation of about 16.00 inches.

Records kept at other places adjacent to the city show that the rainfall increases with the elevation on the Southerly slopes of the neighboring mountain ranges and attains a maximum in a zone along the Southerly slope of the Sierra Madre mountains at about an elevation of 2500 to 3500 feet above sea level, where the average as deduced from the scant observations available is about 22 inches; but as all these observations have been made in the recent dry years the average would probably exceed 30 inches.

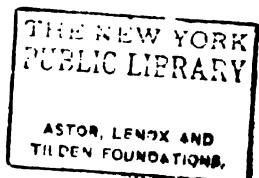
The variations in rainfall from year to year are extreme, ranging from 5.28 inches in the season of 1876-7, to 38.23 inches in that of 1883-4.

The records do not date far enough back to enable us to observe with certainty any tendency there may be to an arrangement of regular cycles of wet and dry periods in our climatology, but if we compare the past nine seasons with the nine seasons preceding we notice a startling difference in the mean annual rainfall, which though possibly accidental is still productive of apprehensive concern to those whose business is in any way contingent on the water supply.

The effect on the flow of the Los Angeles river due to this remarkable falling off in the rainfall came directly under the observation of the writer.



VIEW FROM ANGELINO HEIGHTS RESERVOIR, LOOKING SOUTH.



Los Angeles River.

While as before stated the stream known as the Los Angeles river does not rise in the mountains, it is certain that the greater portion of its water is derived from the many mountain canons discharging their flood waters into the valley where, with the exception of the peak flow of the greater storms, it is all absorbed in the detritus laid down by countless floods of the past.

It is almost incredible with what seemingly insatiable greed flows of thousands of inches of water running from these canons and ravines after protracted storms, are absorbed by the gravelly beds of the flood channels in the valley, while in the river a few miles below the locality of its disappearance there is no noticeable increase in the volume of flow in the placid little brook we extravagantly call a river.

Many times in the past 25 years has the writer restored the ordinary brick and sand dams by means of which the water was directed into the old domestic supply ditch within 24 hours of their destruction by a voluminous flood, and while there was yet running and even for weeks afterwards great volumes of water into the valley above, while in the stretch of the river below and where these dams were situated the water had resumed its normal stage, giving no immediate evidence of the great replenishment of its source.

Under average conditions of rainfall the river begins to appear on the South side of the valley about eleven miles West of the point where it makes its great bend to the South near West Glendale. For the first few miles it increases in volume very slowly, but as it approaches the narrow portion of the valley at the bend referred to, the increase is very marked, the flow reaching about 25 cubic feet per second at the head of what is known as the Main Supply Ditch and which is the first ditch taken out for any purpose.

This water is used for irrigation and to supply the parks of the city. Measurements made at this point at various times this year show that the stream has diminished to about 12½ cubic feet per second.

Following on down the river, it still continues to increase in volume until a point on the Los Feliz Ranch, about a mile above Tropico, is reached. At this point the headworks of the domestic system are constructed, and as it is proposed to retain this locality as one of the points of diversion of the domestic supply, a map of the territory is herewith submitted showing the lands of the old Crystal Springs Land & Water Co., recently acquired by the City, and the various features of water works construction thereon and later to be described.

At this point the flow will have reached between 65 and 70 cubic feet per second, including the water diverted by the Main Supply Ditch. From this point down to the Narrows of Culver street, the river on average averages perhaps 10 cubic feet per second. Below this the flow increases still further in a few miles as the valley broadens, and the depth of water becomes greater.

This gives us altogether a surface flow in an average year of from 75 to 80 cubic feet per second, or say 50 million gallons daily.

Should we be able to rely on this quantity of water every year with certainty, there would not be much cause for worry about our water supply for many years to come, assuming, of course, that proper measures were taken to prevent waste, and that it was all taken for domestic use.

Unfortunately, however, the scant rainfall of the past eight or nine years has served to reduce the flow to such extent that for this year it was less than 54 cubic feet per second, or a decrease below the average year of about 30 per cent.

Comparing the cause with the effect; if we take the rainfall of the last nine seasons, we find the average to have been 10.6 inches per annum as against 18.43 inches for the period of the preceding nine seasons, or a decrease of about 42½ per cent.

In the summer of '92-3, which followed the close of the wet period, there was roughly about 120 cubic feet per second total flow, or considerably over double that of the present year, from which it will be seen that the amount of water retained in the watershed for summer flow is not alone greater from the greater rainfall, but is a greater percentage of such rainfall; in other words, if the rainfall were doubled the amount held by the watershed for summer flow would be much more than doubled.

The quantities of flow above given relate entirely to the surface flow of the stream.

Reducing these quantities to gallons, which will give the lay reader a better conception perhaps than in feet per second as above stated, we have:

Maximum summer flow, 77½ millions in 24 hours.

Average summer flow, 50 millions in 24 hours.

Minimum summer flow, 34½ millions in 24 hours.

The quantity consumed by the domestic system of the City in the summer of 1902, exclusive of that supplied by the West Los Angeles Water Company, averaged about 23½ million gallons daily.

We have no data as to the consumption of the West Los Angeles Co., but believe it to have been about two and one-half to three million gallons, but this quantity was not included in the river flow above given.

It will be seen from the above that there was still left in the river unappropriated to domestic consumption about eleven million gallons. This quantity was used by the irrigators through the zanja system and in the parks.

It is altogether likely that the river flow may continue to diminish through another year or so, or at best merely hold its own, in which case heavy drafts will have to be made on what may be left of this supply next summer. Judging from the number of service connections being made, our population will have increased by from ten to twelve thousand over what it was this summer, with a relative increase in the demand for water.

In the meantime we are expending every effort to increase our supply by development.

WATER DEVELOPMENT.

In a restricted sense there can be no such thing as water development. The world's supply of water cannot be added to or diminished by a single gallon by any agency of man. The water that falls from the clouds in the form of rain and snow is the only source of supply, and the only acts of man that can tend to eke out a short supply are such as are designed to store up the surplus product of periods of abundance for use in those of

drouth, or in his performance of such work as will enable him to reach and procure water that would escape into the ocean, or otherwise get beyond his reach before it had served any human purpose.

Nature herself in the case of the San Fernando Valley gravel deposits provides means for retarding water in its course to the sea, and furnishes such an element of resistance to its rapid run-off and such a large capacity of storage, that if all the water contained therein at any one time were suddenly lifted into the clouds and released in the form of rain in the area of watershed on which it originally fell, it would equal in the amount of precipitation that of the rainfall of possibly ten years combined.

If we define the word development as applied to water in the general sense in which it is used in this country, as being the "product of any artificial means by which we may add to the available supply that may flow to our hands by natural means," then we can classify as a development: First, the building of storage reservoirs to receive the natural flow when it is in excess of our needs. Second, its abstraction from nature's reservoirs deep down in the detritus of the valleys by wells, or in the fissures of the rocks of the mountains by tunneling.

It is obvious that in the first case there is a distinct gain; there can be no question about that.

In the second case there may be or may not be a gain depending somewhat on the extent to which such work is carried, and the conditions existing in the basins from which the water is drawn.

Let us assume, for instance, that wells were sunk down to bedrock on every acre of the San Fernando Valley and pumps inserted in all of them and started simultaneously and operated until the waters stored in the valley were exhausted. The combined flow from all these wells would no doubt make a noble stream while it lasted, but would it constitute a development? The water would be exhausted completely in a month or two at the most; the river flowing perennially from the valley would dry up, and we would be put back to the primitive condition of having no storage basin at all. We should then have to depend on the direct flow of the mountain streams whenever a kind Providence sent rain to fill them, and which we know by observation to be at rare and uncertain intervals.

What then have we accomplished in the way of permanent benefit (and permanence is the most desirable requisite in a water supply)? Nothing but mischief. We would have killed the goose that laid the golden egg.

This is an extreme supposition, but who will place the limit to which this sort of work may be carried without simply anticipating a flow that if left alone develops itself?

If we were certain of a fair rainfall every winter, so great is the mass of porous detritus in the San Fernando Valley, it would not in all probability diminish the flow of the Los Angeles River to any appreciable extent, if quite large drafts were made from its stored waters at some distance up the valley, from where the river begins to make its appearance, for the reason that even in average years there is quite considerable run-off during storms for some of which room would be made by a more depleted condition of the storage basin.

As, however, we cannot depend on a uniform rainfall every year, safety would seem to be in discouraging this sort of development.

There is no parallel between the so-called development as above outlined where the geological construction of the valley is such that the water must of necessity pass through the neck of the valley to escape, and the extraction of water from wells in the broad alluvial plain opening unobstructed in its porous sub-surface to the sea.

In the latter case even clay so extracted is salvage pure and simple of what would otherwise be lost and hence we may call it without hesitancy development in the absence of a more apt term.

The enormous volumes of water that have been drawn from the ground by pumping plants in the last few years in the agricultural sections of Southern California to supplement the failing water supply, have already had the effect of lowering the plane of saturation to an alarming extent in many places, which is proof conclusive that this kind of development may be carried to such excess as to offset nature's effort to restore it. The result is being closely watched by engineers of the United States Geological Bureau.

After all the water it is passing to obtain by ordinary means has been taken from the river and its sub-flow at the two main points of diversion, viz., at the head of the Main Santry Ditch and at the old Water Company's ditch, there will ordinarily be left some water flowing at the narrows in addition to which there will be a sub-flow which if not disturbed would move on down into the measured depths of the porous filling of the outer valley and be lost as far as the City of Los Angeles was concerned. It is to save this water that the tunnel now under construction was designed. The water produced in this way may under the commonly accepted definition be called developed water.

Additions to Present Supply.

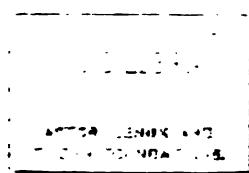
As previously stated, the bedrock at the narrows near the Los Feliz road bridge at the foot of Columbia street has an elevation as determined by borings, of 230 feet above sea level, but as the bed of the river at this point is at an elevation 215 feet above sea level and the borings demonstrated that the filling of the valley there is wholly composed of clean porous sand and gravel, it was assumed that much water was passing beneath the surface that could be saved by a tunnel beneath it in the bedrock and permitting the water to gravitate into it from above through the perforated casings of the borings primarily made to determine the depth to bedrock.

This rock consists of sandstone with some interbedded shale, the whole having a dip almost due south of about 25 degrees, and being consolidated sufficiently to be safely tunneled without timbering.

A work of this character gives us the inverse proposition of a submerged dam as the draft of water to the tunnel makes a trough of depression in the saturation of the mass of gravel in the valley across which no water can pass without falling into the tunnel when the water is being pumped therefrom. Conversely when the water is not being used from the tunnel it is storing up in the depleted sand and gravel. Even should it be found that the flow through this neck has been over-estimated, the water



VIEW FROM ANGELENO HEIGHTS RESERVOIR, LOOKING NORTH.



stored in the many hundred acres of land this tunnel would draw from is in itself a quantity that will many fold pay for the cost of the work.

Although the main pumping station of the works is over one thousand feet below the narrows it was thought best to head the tunnel from a shaft sunk directly at the station to the end that all the pumping machinery might be concentrated at the one point of installation, thereby saving future expense of operation. The borings made with a view to demonstrating the feasibility of this plan showed that the only additional expense due to making the change would be a short increase in the length of the tunnel, so this plan was adopted.

The tunnel has so far progressed about 700 feet without encountering any serious difficulty. The first boring has been passed, but it is the intention not to perforate any of the casings until the tunnel has progressed beyond the third boring at which point a working shaft will be sunk to facilitate the extraction of the excavated material.

The leakage through the bedrock into the tunnel so far amounts to about 800,000 gallons per day, which is removed by a pump installed at the shaft. It is confidently expected that the development from this tunnel will reach from six to six and one-half million gallons daily.

A map of the neighborhood of this improvement work showing not alone the location of the tunnel, but also the Buena Vista Reservoir, the Pumping Station, and the High Gravity Reservoir, now under construction, together with the various pipe lines leading therefrom, accompanies this report.

The construction of the Ivanhoe Storage Reservoir recommended in another portion of this report, will when completed add to our available supply for summer use about 963 million gallons.

Assuming that we lost by evaporation and seepage a prism equal in volume to the top foot in depth, or say an average depth of 24 inches for the eight months the reservoir would contain water, we would still have left about 930 million gallons, from which we would begin to draw about the first of May and have it all used up by the first of October, or in 153 days. From this it will be seen that this import of water would add to our resources something like six million gallons daily.

There is another point in the narrow portion of the valley, about at the place where the branch line to the Bellevue Reservoir leaves the main conduit where quite a large temporary supply might be secured by pumping from wells and discharging the water into the main conduit close by.

The land on which this might be done was acquired by the City with the Water Works. There are good reasons for thinking that continuous pumping at this point would affect the output from the tunnel above described but intermittent draft to supplement the usual supply during heated terms in summer lasting sometimes for a week or more and during which the consumption frequently jumps up to as much as three million gallons a day above the ordinary, could be met by water taken from this point.

The mechanical equipment required here would be very simple and inexpensive as the lift would not exceed 30 feet.

The need for this is not urgent at present nor will it be for some time to come provided the water now used for irrigation is assigned to the use of the domestic supply system.

It is fair, however, in discussing the subject of development to include this, and although it is suggested only as for intermittent use as an auxiliary supply it can be considered as being in effect as useful as the other quantities produced.

Summarizing the quantities thus made available, we have: Supply expected from Narrows tunnel, six million gallons; supply from Ivanhoe Reservoir, six million gallons; supply from proposed auxiliary station, three million gallons; making a total of water developed of fifteen million gallons.

Add to this the minimum summer flow, so far observed, of 3494 million gallons, and we have the snug total of 50 million gallons daily.

PRESENT SYSTEM OF DIVERSION AND CONVEYANCE TO DISTRIBUTING RESERVOIRS.

The main conduit which carries all the water for domestic use to the system now owned by the City, with the exception of about 750,000 gallons per day derived from sources other than the Los Angeles river, heads at elevation 380 feet above sea level and in a brick gate chamber located at the point of the high hill which marks the most Easterly projection of the Cahuenga mountains.

The cover at this point runs close to the base of the hill, and the building foundations are on bedrock which makes it fairly secure from destruction by reason of floods, one of which (that of December 24th, 1886), washed around it with great violence.

Crystal Springs Conduit.

This conduit starts as a tunnel under the point of the hill and runs a distance of 1433 feet to manhole No. 1. The material tunneled through consists mainly of a hard, dark-colored shale, which flakes in exposure to dryness, but remains stable for about half the distance without support, due to tripping water; the balance of the distance being either timbered or bricked. The clear inside width of the tunnel is four feet throughout. From manhole No. 1 here is a concrete invert built in open in 14 inches wide in the rear and arched with brick reaching manhole No. 2 a distance of 1020 feet.

From manhole No. 2 to the north portal of the tunnel through which the water is conveyed into the Buena Vista Reservoir, a distance of 6,152 feet the conduit consists of a 24-inch steel pipe, terminating in the tunnel which is 320 feet long and four feet wide in the rear, about half of which is bricked, the balance being in sound sandstone which is self-sustaining.

Belle Vue Branch.

Branching from the conduit at a point 1168 feet below manhole No. 2 the conduit to the Jefferson Reservoir begins, running southerly through the Manhole 1168 feet, a tunnel 1386 feet long and four feet wide in the rear, 368 feet of which is arched, the balance of the distance being in self-sustaining sandstone. Hence a structure four feet wide having a concrete invert and brick arch and crossing three ravines in about steel supports in an aggregate length of 1000 feet. The distance of 1557 feet, therefore, through 500 feet of tunnel, 1168 feet is inserted, into the Bellvue Reservoir.

The 2185 feet of steel pipe between manhole No. 4 and the branching point to the Bellevue Reservoir should be replaced by 48-inch, giving the conduit a capacity to this point of twenty-eight million gallons daily.

Infiltration Pipes.

Running from the gate chamber above mentioned are two double lines of open-jointed vitrified stoneware pipe, one of which runs up into the Crystal Springs tract before referred to, to its Westerly boundary, a distance of about 1650 feet, where it attains a depth beneath the surface of the ground of about twelve feet. This line consists of a double line of 16-inch pipe, which is reduced by stages to its termination, where it is 12 inches in diameter.

The other line runs nearly due north to within a short distance of the river, and thence meandering Northwesterly to a point in the South boundary of the 32-acre tract known as the Ferguson land, a distance of 3656 feet, where it attains a depth of about 14 feet below the surface of the ground and about 12 feet below the surface of the water flowing in the river at that point. This line starts from the gate chamber with two 24-inch pipes, and is reduced by gradations of two inches, terminating with 12-inch pipe.

These pipe lines are designed to collect water from the porous sandy deposits of the valley washed down in times past from the mountains and deposited by the river in its meanderings from one side of the valley to the other.

The sections of pipe are laid together with open joints to permit the inflow of water, and are bedded in coarse gravel and broken rock to prevent the inflow of sand.

They have served well the purpose for which they were intended, and at the time they were first laid supplied sufficient water for the domestic needs of the City, although they always gave trouble by the penetration of roots tending to obstruct them.

They now yield in the neighborhood of six million gallons of water daily, and the water, even during the most turbid condition of the river, is always bright and pure.

This system of infiltration pipes comprises the sole method of diverting water for domestic uses from the river other than the direct means of damming the water and taking it directly from the surface in an open ditch. As the City has been using all the water flowing in the river at this point for the last two years, it will be seen that about 17 million gallons daily have been diverted by this crude method, the City being fortunate in the fact that there have been no prolonged freshets to roll the water during that period.

As this condition will have to be amended and measures taken to draw all the water from beneath the surface by infiltration and at a sufficient depth to be beyond the danger of disturbance from floods, and also to insure the supply from possible contamination due to increasing population in the San Fernando Valley, a proper gallery will have to be constructed at this point, as it is the design to continue this location as the point of collection and diversion of all the water that passes by sub-flow, the point of diversion to be established on the Pomeroy & Hooker land.

During the summer now closing, the quantity of water obtained at this point, including that drawn from the infiltration pipes, averaged 22,800,000 gallons daily.

This quantity under the conditions of rainfall that have prevailed for the last few years, would be materially reduced by natural causes until such time as our normal conditions were restored. There are artificial conditions, however, to be considered, that will certainly reduce this flow permanently. The Main Supply Ditch at present only carries the natural surface flow of the river at its point of diversion, but it is designed at some future time to construct works to take in some of the sub-flow at that point. It follows then, as there is very little watershed contributing to the river between the head of this ditch and that of the old Water Company's ditch, that any works drawing water in excess of the natural flow at the upper point will diminish the natural flow at the lower. Of course, it is to be expected that some compensation will accrue from the fact that the new gallery at the lower point will also be designed to draw its supply from a greater depth. It must also be borne in mind that we are now probably at a period of minimum flow, so that it would seem that a designed capacity of 28 million gallons daily would be the proper size for this location, and the plans for the work herewith submitted are prepared accordingly.

There are no plans submitted with this report for the headworks at the head of the Main Supply Ditch for the reason that a thorough investigation will have to be made by means of borings and otherwise of the bordering rock of the valley at this point before plans can be intelligently prepared.

The need for this preliminary examination will be apparent when it is stated that it might easily involve an additional expense of fifty thousand dollars or more in the construction of these works by the prosecution of a design that did not properly fit the conditions.

The unsettled state of the Pomeroy and Hooker suit prevents this investigation.

RESERVOIRS OF PRESENT SYSTEM.

The main Distributing Reservoirs receiving the water from the gravity conduits above described, are the Buena Vista, situated in a small ravine in the Elysian Park, and about one-quarter of a mile Northerly from the west end of the Buena Vista-street bridge, and the Bellevue Reservoir situated near the West boundary of the City, about half a mile Northerly from the West end of Temple street.

These two reservoirs supply all that portion of the City which is under gravity pressure, and which, in point of quantity, amounts to about three-fourths of the total water supply.

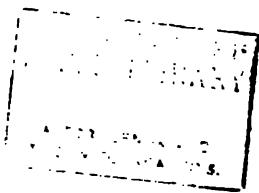
In addition to its function as a gravity reservoir, the Buena Vista supplies all the water to the pumps that is consumed in the districts supplied by pumping with the two small exceptions before mentioned.

This reservoir has an elevation on the spillway of 374 feet above sea.

The reservoir was constructed by damming the ravine in which it is situated with a puddled earthen dam and excavating the reservoir site to bedrock. It has a capacity of about 13 million gallons, and is a well-built



BELLEVUE RESERVOIR AT INTAKE.



structure of ornate design, and affords a valuable scenic attraction to the park. It is connected to the gravity system of the City by a thirty-inch main, and the pumps in the main Pumping Station close by draw their water from it.

It is in need of some repairs and alterations in the valve chamber, and also needs cleaning.

The Bellevue Reservoir was built in 1895, to meet, by a more direct route, the rapid growth of the City about Westlake Park. It is a well-built structure covering a surface area of a little over five acres, and has a depth in the deepest part of 40 feet, and a capacity of about 39 million gallons. Much trouble was experienced with it at first on account of its great size permitting the water to periodically accumulate a growth of algae, which, on maturing, would impart a green color and decided fishy and offensive odor to the water. This was afterwards effectually remedied by the construction of a roof over it, which, though light and comparatively inexpensive, proved a complete success.

The elevation of this reservoir is 380 feet above sea level, or six feet greater than that of the Buena Vista. They both discharge into the same pipe system, forming a belt line, which accounts largely for the effectiveness of the small mains.

The main pipe from this reservoir is a 30-inch cast-iron pipe laid down Hoover & Seventh street, and thence branching into pipes of smaller size.

The Beaudry Reservoir is located just north of the corner of Figueroa and College streets, and is supplied by pumping from the Buena Vista Pumping Station through an 18 inch steel force main 8600 feet long, the lift being 92 feet. The elevation of the surface of high water in this reservoir is 466 feet, an elevation not great enough for most of the territory it now serves, especially in view of the tendency to higher buildings in this district. As will be seen by the colored map showing the proposed new arrangement of distribution, the lower portion of the territory now supplied by it will be placed under the "High Gravity" or blue district, while the elevated area will be included in the Pump System or red area, throwing this reservoir out of commission.

The Hazard Reservoir on the hill top back of the County Hospital, although of about the same elevation, need not be abandoned, as it will serve as a compensating reservoir for the portion of Boyle Heights in the red area, this district not requiring the full new pumping pressure, it being nearly low enough to be served by the "High Gravity" water. An automatic device can be devised to keep it full from the twelve-inch main supplying the red area in East Los Angeles. It has a capacity of about 650 thousand gallons, and needs some inexpensive repairs.

The hill on which it stands is in the axis of the structure before referred to, and is hence subject to crustal disturbance. A few years ago a crack developed along its summit, which ran diagonally across the reservoir, causing it to leak badly. This crack was repaired in the sides and bottom of the reservoir by excavating a narrow trench deep down the crack and filling it with concrete. Its insignificant capacity insures it from existing particular hazard should it be destroyed by this means, which is not likely, at least not

suddenly, as it is founded on and excavated partly in the rock, which would prevent its rapidly washing out a breach wide enough to cause any great damage.

The Angelino Heights Reservoir is located on the high summit at the head of Beaudry avenue, and is supplied by pumping from the Buena Vista Pump Station through a new 18-inch steel main 6900 feet long. It has an elevation of 596 feet above sea level, but can easily be raised by construction several feet higher. In its present state it is a mere naked excavation in the shale rock of the hill, and has always leaked badly.

The property on which it stands is only partly owned by the city, the balance being owned by the Sisters' Hospital, which has a contract by which they receive free water for the hospital in consideration for its occupancy and use by the City.

As it is designed to permanently supply water to all the red area from this elevation, and it is necessary to either substantially rebuild this reservoir or select a new site adjacent thereto, it would be advisable to take some steps looking towards the purchase of the portion of the land owned by the Hospital, as it would hardly be expedient to maintain a partnership arrangement in this important adjunct to the system.

The reservoir recently acquired with the works of the Highland System is located just north of Garvanza, and is an earth structure of about seven or eight million gallons' capacity, and has an elevation of 600 feet above sea level.

This elevation and its position makes it ideal to work in harmony with the Angelino Heights Reservoir for the supply of the extended arm of the red area lying North of the Buena Vista Reservoir. We are now extending a main beginning with 16-inch and ending with 12-inch to this reservoir from the Buena Vista Pump Station. This main will be provided with a bye pass at the Pump Station, putting it in connection with the Angelino Heights Reservoir, so that in effect its capacity will be doubled to meet any excessive draft made on it between the two reservoirs which are at its extreme ends.

This reservoir will have to be roofed to prevent the growth of algae and aquatic plants, which at present taint the water by their decay.

In viewing the map of the pipe system as proposed, it will be seen that it is intended to supply the blue or "Low Gravity" area from two distributing reservoirs connected together by a system of mains in circuit through the business section of the city in the manner which has proved so safe and effective in the case of the two "Low Gravity" reservoirs. One of these reservoirs is now being constructed in the Buena Vista Cañon, and several suitable sites are available for the other one in the neighborhood of the locality indicated on the map.

They will have a capacity of about ten million gallons each, and an elevation of 439 feet, so that as they are designed to serve the business section of the City as well as portions of East Los Angeles and Boyle Heights now supplied by "Low Gravity" water, they will increase the pressure in those districts by 65 feet, enabling a good fire stream to be drawn from the hydrants without an engine.

The City is to be congratulated in that the topography is such as to afford good sites for distributing reservoirs, but she is not so fortunate in the matter of storage or impounding reservoir sites.

There is one good site, however, belonging for the most part to the City, and very advantageously located, which has recently been surveyed, a map of which is herewith presented, together with alternate plans for its dam.

As shown on the map, there are two sites suggested for the dam. The upper one would require 91,000 cubic yards of earth for its construction, and would impound 640 million gallons of water.

The lower one would take 225,548 cubic yards to construct, and would impound 963 million gallons.

Either of these dams requires that additional land to the south of the 110 acres owned by the City should be purchased, and as the owner of this land has evinced a disposition to sell it to the City for this purpose, it should not be a hard matter to arrive at proper terms for its acquisition.

The flow line elevation of this reservoir would be 445 feet above sea level, and when full would have a surface area of 128.97 acres, if the lower site were selected for the dam.

As this reservoir would be full ordinarily from about January 1st to well along in May, it would supply an attraction, nestling as it does among beautiful rolling hills, unsurpassed by anything within easy distance of the city, and would easily be worth its cost for this purpose alone, without at all considering its utility.

It is often asserted, but still is not well established, that water cannot be preserved in a potable condition in this country in an impounding reservoir. The fact that it did not keep well in the small distributing reservoirs of the works proves nothing, as it may be found that in a reservoir of this great size the influences that work to render the water unpalatable will not have the same effect as in a smaller pond. However that may be, it will readily be conceded that in her beautiful parks, Los Angeles has an asset of great value, and as these require large quantities of water for their maintenance which must be drawn from the common source, it is clear that if we are enabled to supply them from water stored in winter, when there is abundance, the supply left for domestic use will be increased by that much.

It may be urged that in the event of a wet winter the river will supply all the water needed by the City for all purposes, but it is a well known fact that the river makes no sudden response to a single year of abundant rainfall, as proved by the flow continuing to diminish in the summer of 1901 following the 16.09 inches of rainfall of the previous winter. It is reasonable to assume that it will be just as slow to recover its wonted flow as it was to diminish it, and it is wise to be a bit pessimistic in matters of lesser moment to our welfare as that of the water supply. Besides, who can say in the absence of extended records of our meteorology, but what the recurrent wet winters of ten to twenty years ago were the abnormal, and those of the past eight or nine years the normal, which is quite as likely as the reverse. In any event, there is safety in developing our water sources to the very utmost limit, and the construction at as early a date as possible of this reservoir is urgently recommended.

THEIR REPORT OF THE

It will be necessary to realize that a ditch is the Main Supply Ditch, and it is extremely undesirable that it is present exists, it is but a mile from a point exposed to damage and pollution from roaming stock, and situated near many houses.

It will be seen from the plan, that the intention to continue as a diversion point at place where this ditch ends. The fact that final adjudication has not yet been had in the dissolution of proceedings brought by the City to acquire the land, gives us the right to act outside of the head of this ditch, and not interfere with it, there is no danger conduit that will be safe from the dangers above mentioned.

We need not wait either for the completion of the headworks to be built at that point before proceeding with the conduit, as there is water enough flowing here to supply all the demand we are at present prepared to make on it.

It is the intention to re-adjust the grade of this ditch which is at present five feet to the line to a grade of 2 1/4 feet to the mile, beginning at its upper end at elevation 458.00 feet above sea level. This will enable us to reach by gravity elevation 445 feet at the proposed Ivanhoe Reservoir, and also enable us to reach the new "High Gravity" reservoir in the Buena Vista Canon at elevation 439, allowing for a depth of two feet back water in the conduit; hence its use will abolish the necessity of all pumping, except for that required in the red area.

A capacity of 50 cubic feet per second is not too much to provide for in the design of this conduit, as it is believed to be quite easy in ordinary years to obtain that quantity where this ditch heads, by the construction of proper works to reach some of the sub-flow at that point.

For many reasons, both economic and sanitary, it is highly desirable that as much water as it is possible to extract be taken out here. First, for the reason that the high elevation of delivery into the distributing reservoirs enables us to discharge it where it may happen to be most needed. Second, it is manifest that the more water is taken out here, the farther down the channel it will be before the water appears at the surface again, thus shortening the distance through which it will have an exposed flow before it reaches the next point of diversion at the Crystal Springs head-works, and hence decreasing its liability to pollution, as well as saving a considerable volume from evaporation and in maintenance of useless plant life that is usually found bordering on the streams in sandy river bottom lands.

After a great deal of consideration as to capacity of this conduit, and having a survey made by the San Joaquin Water Company, we have a conduit capacity of 50 cubic feet or nearly 30-million gallons daily. There is no conduit or canal fully automated.

POPULATION AND CONSUMPTION.

For many years now, we have talked with our works engineers that the use of water in cities and towns grew faster than their population increased; and often asked, can the use be quite unsatisfactory? We know as the city grew,

the use of water grows, unless we are to assume that there is a definite, uniformly low supply of water, because it is clear beyond argument that said increase in use was due to increased population. Although there is no apparent

that while the water in some places might be free enough, the works to convey it to the consumer cost money, the prudent and frugal-minded citizen began to ask himself why he should be taxed to help enlarge a works to supply his neighbors' extravagance, or what was still worse, his criminal idleness, and after asking himself several times without satisfactory response, he resorted to the expedient of asking the water works officials about it, with the result that in a short time, instead of it being a source of pride to the Superintendent to be able to say that he supplied his consumers with such a large amount of water, quite a rivalry sprang up among this useful and much-abused fraternity, as to who furnished the least, consistent, of course, with satisfactory service.

This commendable strife has resulted in the solution of many grave problems with regard to the water supply in a number of cities throughout the United States, and has served effectually to dispose of the fallacy that the larger the city the more water required by each individual.

A large number of instances can be cited from the recent annual reports of cities, that notwithstanding great recent additions to their population, they are using even less water than in the years preceding the accession to their growth.

In the year 1901 the City of Los Angeles had the unique distinction of using more water per capita than any city in the Union. With a closely estimated population of 85,000 people supplied from the works of the Los Angeles City Water Co., we reached the astounding consumption of over 3 million gallons per day, or about 366 gallons per capita. After the works were taken over by the City the Commissioners appointed for their management, set themselves to the task (the need being urgent, owing to diminishing available supply) of finding out what became of it all, with the result that by the application of a few hundred meters the consumption was cut down nearly three million gallons per day, notwithstanding the fact that there were at least 10,000 people added to our population.

While we must not expect that this City can hope to reach a low per capita consumption, as measured by that of European cities, and it is not desirable that she should, a bountiful supply of water being necessary to the maintenance of the beauty for which she is famous, still the use of the 1200 or so meters now in use has supplied us with means to fairly compute the amount of water that can be saved without curtailing the irrigation at all of the city in the least.

From the figures thus derived, it is estimated that a per capita consumption of 150 gallons daily is ample for all our needs.

This is 25 per cent greater than the average consumption of 120 cities in the United States, ranging in population from 1,000 to 1,000,000, for the year 1900. Later partial reports from these cities show that the general application of meters in the past year or two has served to reduce the per capita consumption to less than 100 gallons, so that we think the allowance of 150 gallons for the City of Los Angeles extremely liberal.

This would make our present supply without further development of the water now used for irrigation through the zanja system were all devoted to domestic consumption, sufficient for a population of about 220,000 people, in the area supplied by the works owned by the City. If we add to this

the population that can be supplied by the water distributed by the West Los Angeles Water Company, the figure will come near to reaching a quarter of a million.

All this assumes, of course, that our supply is at present at a minimum.

DENSITY OF POPULATION AND MILEAGE OF PIPE IN PRESENT DISTRIBUTION SYSTEM.

It is doubtful if there is a city, great or small, in the United States in proportion to population, that requires as much pipe to reach all the points of the water system as does Los Angeles.

This is due to the great area of the city and the manner of distribution of her population. The City early acquired the inconvenient habit of growing in spots, first in one locality, and then another, jumping over broad intervals of space just as eligible for residence purposes between the two, in a manner most exasperating to those who had to follow up these capricious movements with the necessary public utilities.

To illustrate this diffusive tendency, if we were to condense our population so as to have five persons to each lot 50 by 150 feet, and allow 60 feet wide for the streets, with the blocks 330x660 feet between street centers, our estimated population of 120,000 people would all be contained within an area of 7 4/5 square miles. As the City has an area of about 43 square miles, it will be seen that whatever else we may lack, we are not cramped for room in which to grow.

There are now in use about 337 miles of water pipe in the streets of the City, and as might be expected under the above circumstances of growth and the rapidity with which it was attained, this pipe system is a marvel of attenuation alongside of which Barnum's living skeleton would be considered the very embodiment of unwieldy corpulence.

By the judicious extension of large mains woven through this gauzy network of small pipes, they have been made to serve their purpose with remarkable efficiency as far as domestic supply is concerned, but it is a well-known fact that the protection they afford against fire is sadly lacking. Great strides have been made in the past few months in catching up in this particular, and it is to be hoped that within a year we will not be much behind other cities of our size in regard to this important function of the water service.

There are now in use 676 fire hydrants, 28 of which are of the double-nozzle type.

It would be a wise move to discontinue the practice of filling sprinkling carts from the hydrants, as such use is very destructive to them, and a slovenly method from every point of view.

The following is a table of the quantities of pipe in use in the present distributing system:

	feet	2-inch	Standard	Screw.
927,543	"	3	"	"
56,349	"	3	"	"
6,319	"	4	"	"
21,910	"	3	Cast	"
308,254	"	4	"	"
8,370	"	5	"	"
120,576	"	6	"	"
860	"	7	"	"
53,827	"	8	"	"
32,725	"	10	"	"
47,057	"	12	"	"
0,722	"	16	"	"
2,099	"	18	"	"
0,687	"	20	"	"
8,320	"	24	"	"
0,228	"	30	"	"
3,080	"	3	Cement Lined.	
1,340	"	4	"	"
7,209	"	6	"	"
10,949	"	8	Sheet Steel.	
3,360	"	10	"	"
17,352	"	11	"	"
3,909	"	12	"	"
7,760	"	14	"	"
2,725	"	16	"	"
17,718	"	18	"	"
16,200	"	22	"	"
1,735	"	30	"	"

PROPOSED DISTRIBUTION SYSTEM.

As previously stated, the topography of the City is such that suitable distributing reservoir sites are abundant, but the irregular meandering outline of the elevations makes the study of economical methods of distribution a perplexing subject, where water pipe constitutes such an expensive item as it does on this coast.

The elevations at which the water could be delivered into the city from its source and the locations of the various reservoirs with respect to the districts they were designed to supply were the controlling factors in the design of the trunk line system, and much study was necessary to avoid traversing the same section with two lines of different systems, and thereby involving increased expense for pipe.

Another important point to be considered was how best to distribute the water so as to contract the area to which it would be necessary to pump the supply.

The map herewith presented explains how it is proposed to accomplish all this.

It is proposed to supply by gravity all of the region left uncolored from the Buena Vista and Bellevue reservoirs, combined as they are now, into a common pipe system and to be known as the "Low Gravity" System.

The portions colored blue are to be supplied by gravity from the new "High Gravity" reservoir now under construction, and later to be additionally fortified by the construction of another reservoir somewhere in the vicinity of Alvarado and Reservoir streets as shown. This is to be known as the "High Gravity" System.

The red colored districts are to be supplied by water pumped from either the Buena Vista or new High Gravity reservoirs at will, as the mains from each pass right by the Buena Vista Pump Station, which it is proposed to retain as the main and only pumping station of the works.

The area shown in yellow it will be noticed constitutes the elevations which are above the 550-feet contour, and it will be seen that no provision is made in these plans to provide those sections with water except such of them as happen to lie closely adjacent to the reservoirs designed to supply the red zone which being 600 feet above sea level, can furnish water with a tolerable head nearly up to their own level, especially to property that happens to be ranged along the mains on their way to lower ground.

By far the greater portion of this area is made up of rocky and barren hill tops, but there are a few of the elevations that in the near future may attract investors to their eligibility as hotel or sanitarium sites. Some of those hills rise to a height of 800 feet and over, above sea level, and as they are quite widely detached, each would require individual treatment in the way of water works construction, as a plant comprehensive enough to include them all would be prohibitive in cost.

The treatment of this subject being more of a financial one than one of engineering, we will here dismiss it with the suggestion that a declaration should be publicly made as to the future policy to be pursued with regard to it; in other words, a limit of elevation should be established above which it is not the purpose to deliver water, at least not under the rules and rates prevailing for lower levels.

The various pipe systems as shown embrace all the sizes down to six-inch, and the design in some particulars was influenced by a desire to save disturbing whatever was useful of the present system. This was possible to a somewhat greater extent than was popularly supposed by reason of the fact that the design here submitted has for some years been anticipated, so that the more important recent work harmonizes with that herein proposed.

When completed as to the larger mains the plan here outlined will not alone be large enough in capacity, but will be elastic in the matter of meeting any spasmodic growth the City may develop in any direction, and will be capable of delivering fifty million gallons of water daily to her inhabitants. This quantity on an estimated consumption of 150 gallons per capita will provide for a population of 333,000, and it is to be hoped that by means of the various plans outlined under the head of Water Development in this report, this amount of water will be obtained from the Los Angeles River watershed.



ROOFING, HILLVIEW RESERVOIR.

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PUMP STATION.

The primary consideration in the selection of a site for a pump station requires as a matter of course that it should be contiguous to the supply of water to be pumped. If this location should also be geographically near the center of the district to which the water is to be pumped, so much the better, as a saving is effected thereby in the length of force main required, and in the frictional resistance to flow which is directly proportional to the length of the main.

The next important requisite is convenience of delivery of the fuel supply.

If we examine the map of the works proposed herein, it will be noticed that the present Buena Vista Station has all these advantages, and it is there possible to concentrate all the pumping equipment of the System.

The Buena Vista Reservoir, from which the supply is to be drawn, is less than 300 feet away.

The shaft leading down into the infiltration tunnel is so located that it can be included within the walls of the building.

The 24-inch main from the new "High Gravity" reservoir will pass within a few feet of it, so that water may be discharged into it by the pumps or drawn from it as occasion may require.

The sidetracks of the Southern Pacific Railroad are right in front of the building, and our fuel supply of crude oil is now pumped directly from the cars into the tanks.

The present equipment of this station consists of three horizontal tubular boilers of a nominal rating of one hundred horsepower each.

One triple expansion, horizontal, duplex, condensing pump of a nominal capacity of four million gallons in 24 hours.

One pump of the same type of a nominal capacity of five million gallons in 24 hours.

One compound, horizontal, duplex, pump of a nominal capacity of four million gallons in 24 hours, and used as an auxiliary.

One horizontal, duplex, power pump driven by a Pelton Water wheel and having a capacity of 3,500,000 gallons in 24 hours.

It is proposed to take this pump out, as the consumption of water has grown to such an extent that it is only in the night-time in winter that water can be spared to drive it.

It will be necessary to install a pump to lift the water from the infiltration tunnel, and designs and specifications have been prepared for this machine, together with a pair of high-pressure water tube boilers of a nominal rating of 250 horsepower each, to drive it. This will be a high-class combination, and modern in every respect.

The two triple expansion pumps are first-class machines of their type and highly efficient as to fuel consumption.

They are the most durable, and in every way reliable type ever used in water works practice. The older one of the two (which, by the way, was a show pump at the recent Atlanta fair) has a record of having run seven months continuously without stopping. The other one has but just been placed in position, and will no doubt prove as efficient as its mate.

After the installation of the machinery above described, a building of architectural design comporting with the surroundings which constitute one of the most frequented and beautiful spots in the Elysian Park, should be built to house the plant.

The site is a conspicuous one, being in view of the passing trains on all three railroads, and the building should be made a credit to the City, architecturally as well as mechanically.

Under the present system, and when the total consumption of water was between 23 and 24 million gallons daily, as it was last summer, the quantity required to be pumped at the Buena Vista Pump Station to supply the elevations too high to be supplied by gravity, averaged about four and one-half million gallons daily.

This does not include what was pumped from the wells in Pasadena acquired with the plant recently purchased from the Highland Water Co., and which amounts to about 300,000 gallons daily, and is used to supply the patrons of that system until such time as the pipe line is completed from the main Pumping Station.

The reason for the abandonment of this source is the great cost of operating there on such a small scale, it costing about two and one-half cents per thousand gallons to lift this water about 60 feet high, as against about one-third of a cent per thousand gallons 120 feet high at the main station. In other words, it costs 15 times as much to lift a given quantity of water a given height at the Pasadena Station, as it does at the Buena Vista Station. This great difference is accounted for by the fact that we purchase electric power to run the Pasadena Station, the work there being too small in amount to pay for the installation and operation of a steam plant that would require expensive personal attendance night and day. This power and the man to operate it costs us about \$235 per month, or practically the same as all the fuel used in pumping the four and one-half million gallons at the Buena Vista Pump Station.

There is another small station at the East Side Springs near the junction of Marengo avenue and the Mission Road, from which about 300,000 gallons of water daily was pumped to Boyle Heights during the summer season. As, by the location of the Southern Pacific Railroad shops on the grounds adjoining these springs and the consequent increase in density of population thereabouts, the water heretofore derived from this source is liable to become contaminated, its origin being merely the storage afforded by a thick gravel measure near the surface, it is the purpose also to abandon this source. The cost of operating this plant averaged \$115 a month during the summer season.

About two-thirds of the water pumped from the Buena Vista Station, say about three million gallons daily, goes into the Beaudry Reservoir, and under the present system about 800,000 gallons of this is re-pumped by the College street plant into the Angelino Heights Reservoir, 130 feet higher.

The cost of operating this plant averages nearly \$300 per month.

It will therefore be seen that under the new plans which contemplate the concentration of all the work of pumping at the Buena Vista Station

there will be a saving effected of \$62 per month by the abandonment of the three small plants, with an estimated addition of about \$75 per month, to the fuel consumption at that station, making a net saving of \$56 per month.

Assuming that the plans herewith submitted for the various improvements proposed, are sufficient to fully explain their character and the general design of their construction, we append the following estimate of their cost, on the basis of the present market prices of labor and material, which in all probability will not be exceeded at any time during the prosecution of the work.

MAIN SUPPLY CONDUIT.

Station O to Station 75.

7500 feet of Concrete Construction, including excavation and back-filling complete, @ \$5.00.....	\$37,500.00
Head gate and blow-off for same.....	3,000.00
Station 75 to Station 253, 17,800 feet of sheet steel inverted siphon	
@ \$6.15	106,470.00
1900 feet conduit from Station 253 to reach Ivanhoe Reservoir,	
@ \$5.00.....	7,500.00
Division gate chamber	3,000.00
Southeast branch of Main Supply Conduit from division gate chamber to Buena Vista High Gravity Reservoir, 16,976 feet,	
@ \$4.35	73,845.00
Tunnel section of same, 720 feet @ \$8.00.....	5,760.00
High Gravity Reservoir, in Buena Vista Cañon.....	20,000.00
South branch of Main Supply Conduit, 10,000 feet @ \$4.35.....	43,500.00
South branch High Gravity Reservoir, including real estate.....	30,000.00
Ivanhoe Storage Reservoir (construction).....	75,000.00
Real estate for same	25,000.00
Conduit therefrom to Bellevue conduit (in tunnel).....	25,000.00
Improvements in Bellevue conduit tunnel, to enable water to be drawn from Ivanhoe Storage Reservoir into old Water Company main conduit	15,000.00
lnfiltration gallery at Crystal Springs diversion point, 6000 feet	
@ \$18.00	108,000.00
Improvements to old Water Company conduit.....	6,000.00
Improvement of Angelino Heights Reservoir.....	20,000.00
Improvement of Garvanza Reservoir.....	3,000.00
Improvement of Hazard Reservoir.....	2,000.00
Repairs to Buena Vista Reservoir.....	4,000.00
Additions to Buena Vista Pump Station.....	10,000.00
New machinery therefor	18,000.00
Narrows tunnel	35,000.00
Shop, stable and pipe-yard and buildings.....	30,000.00

Forward, \$709,575.00

EXTENSION AND IMPROVEMENT TO PIPE SYSTEM.

	Brought forward,	\$709,575.00
Cast iron pipe from 6 inch up, 17,927 tons @ \$45, laid.....	806,715.00	
Fittings for same, 255 tons @ \$60.....	15,300.00	
4-inch cast iron pipe, required to replace 2-inch and 3-inch, 6931 tons, @ \$45, laid.....	314,895.00	
Fittings for same, 120 tons @ \$60.....	7,200.00	
Sheet steel pipe, 16-inch to 36-inch, inclusive, as per contracts.....	30,976.00	

GATE VALVES.

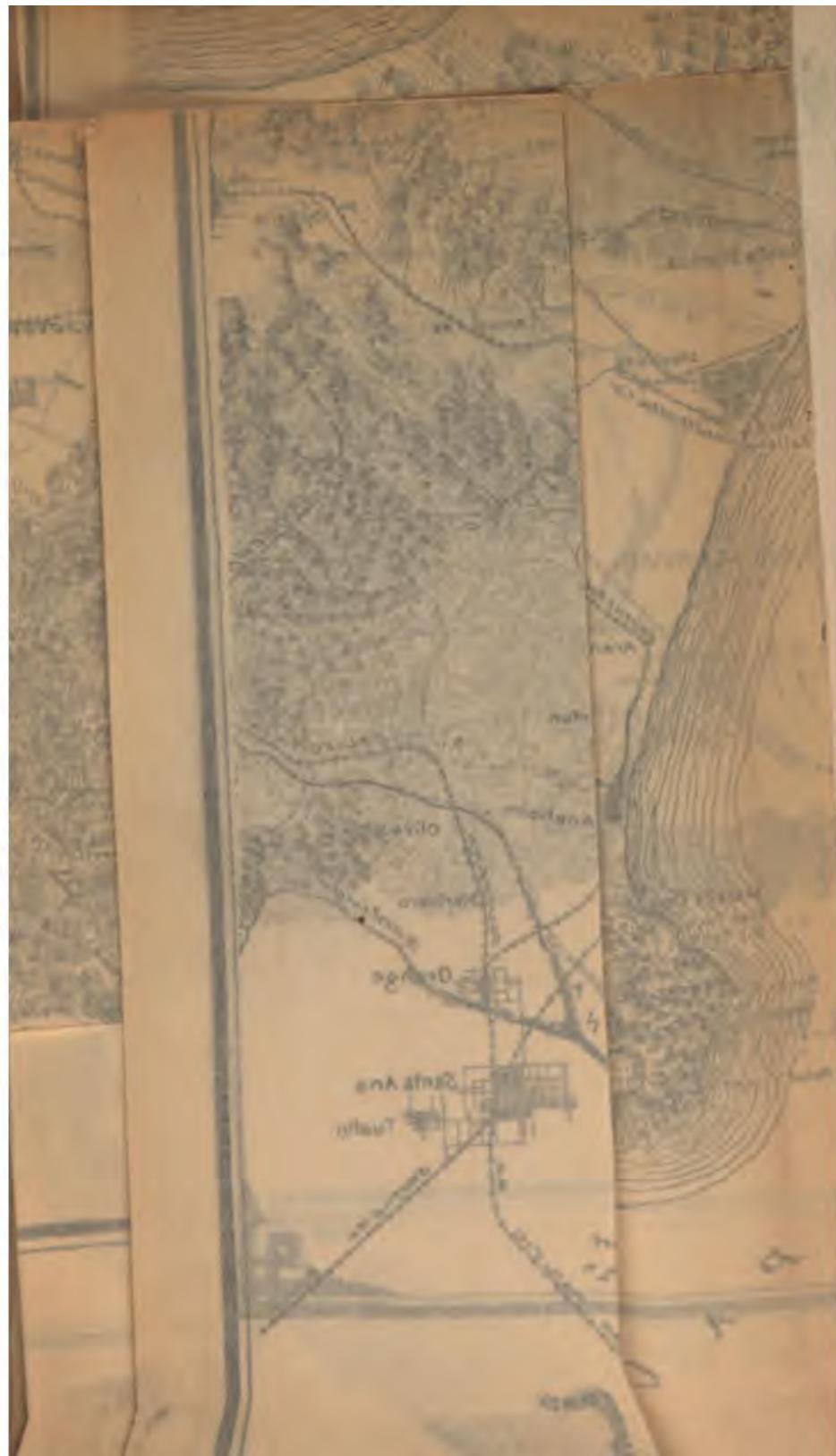
500 4-inch at \$ 8.00	\$ 4,000.00
125 6-inch at 13.00	1,625.00
35 8-inch at 18.00	630.00
60 10-inch at 27.00	1,620.00
80 12-inch at 35.00	2,800.00
16 16-inch at 75.00	1,200.00
8 18-inch at 100.00	800.00
7 20-inch at 125.00	875.00
4 24-inch at 180.00	720.00
2 30-inch at 300.00	600.00
2 36-inch at 409.00	818.00
1000 Fire Hydrants at \$35.00 set.....	\$ 15,688.00
	35,000.00
	<hr/>
	\$1,935,349.00

As may be gathered from the descriptive matter relating to the features in the above table, it will not be necessary to complete all the above work for several years to come; in fact we believe that if it is so desired the expenditures may be made to keep pace with the revenue of the Works, without embarrassment to our progress and probably with greatly increased economy in the prosecution of the work.

Respectfully submitted,
Wm. MULHOLLAND,
Superintendent.

Approved:

FRED EATON, Consulting Engineer.
HARRY F. STAFFORD, City Engineer.



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RIVETS
Los Angeles - San Gae
— at the —
Water Shed
— at the —
M.A.F.

Supplemental Superintendent's Report

FOR THE PERIOD ENDING NOV. 15, 1902

To the Honorable Board of Water Commissioners.

GENTLEMEN: Since the general report on the improvement of the plant, submitted by myself and associates, covers fully the subject of its present condition, it remains only necessary for me, in this, the first Annual Report of the Department, to submit in tabular form a list of the various items composing it, to the end that each succeeding report may mark the progress made from its original condition, when the city acquired it.

It will be observed from the table of pipe added to the System since February, that notwithstanding the fact that your Honorable Body deplores the conditions which make such an expedient necessary, we still continue to lay pipe as small as two-inch for street mains. This the public will readily understand to be due to the great spurt in growth our City is at present having the good fortune to experience. Fully one-half of this great accession to our population is spreading itself out on territory remote from the old pipe lines, and even were we not limited in funds to purchase large pipe to make the necessary extensions to cover these new districts, the condition of the pipe market is such that we could not obtain it fast enough for our present needs.

PIPE.

SIZE	QUANTITIES IN PIPE SYSTEM NOV. 15, 1902	PIPE ADDED TO SYSTEM SINCE FEBRUARY 1, 1902	GATES IN SYSTEM NOV. 15, 1902
2 inch	989,626	51,186	2,576
3 inch	84,159	449	88
4 inch	385,812	19,911	508
5 inch	8,370	.....	8
6 inch	138,791	17,408	191
7 inch	2,089	1,149	1
8 inch	72,472	2,465	62
10 inch	36,085	6,334	29
11 inch	7,352	.....
12 inch	66,529	4,336	44
14 inch	7,760	.....	3
16 inch	16,277	8,323	8
18 inch	19,817	6,473	5
20 inch	9,687	.....	3
22 inch	16,200	.....	5
24 inch	8,320	.....	2
30 inch	10,963	.....	4
1,890,309 ft. — (358.01 miles)		124,044 ft. — (23.49 miles)	3,537

ANNUAL REPORT OF THE**HYDRANTS.**

Fire Hydrants in system Nov. 15, 1902.....	660
Services in system Nov. 15, 1902.....	26,076

SERVICES ADDED SINCE FEBRUARY 1, 1902.

SIZE	WARDS									TOTAL
	1	2	3	4	5	6	7	8	9	
½ inch	519	95	69	176	84	905	134	24	130	2136
¾ inch	92	28	45	134	34	182	53	3	35	606
1 inch	9	8	20	37	11	7	17	8	5	122
2 inch	1	6	2	.....	4	10	7	.....	.....	30
3 inch	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4 inch	.....	.....	.....	.....	1	.....	.....	.....	.....	1
6 inch	.....	1	.....	.....	.....	.....	.....	.....	.....	1
	620	133	140	349	129	1099	214	42	170	2896

NOTE.— 373 Services on Highland System, and
105 Services on the Kysor & O'Dea Tracts are included in
the above.

METERS IN USE NOVEMBER 15, 1902.

KINDS	SIZES							TOTAL
	½ in.	⅓ in.	⅔ in.	1 in.	2 in.	3 in.	4 in.	
Reg. Crown.....	0	142	50	9	17	3	0	221
"A" Crown.....	0	0	4	0	0	0	0	4
Lambert.....	0	141	197	78	5	2	0	423
Trident.....	0	212	2	1	25	1	2	243
Nash.....	0	2	1	3	3	1	1	11
Hersey.....	0	21	0	9	5	0	0	35
Bee.....	2	0	0	0	9	2	0	13
Keystone.....	0	0	0	25	0	0	0	25
Columbia.....	0	31	0	0	0	0	0	31
Worthington.....	0	0	1	0	0	0	0	1
Niagara.....	0	1	0	0	0	0	0	1
								1008

NOTE.— 36 of these are private.

BOARD OF WATER COMMISSIONERS.

39

METERS IN STOCK NOVEMBER 15, 1902.

KINDS	SIZES, IN INCHES									TOTAL
	5	6	8	1	1½	2	3	4	6	
Reg. Crown.....	6	50	6	4	0	1	0	0	0	67
"A" Crown.....	0	8	2	0	0	0	0	0	0	10
Hercy.....	0	11	0	5	0	0	0	0	0	16
Lambert.....	0	257	127	18	0	1	0	0	0	403
Keystone.....	0	0	0	.53	0	0	0	0	0	53
Trident.....	0	60	0	0	0	15	8	4	3	90
Nash.....	0	3	0	3	0	1	0	0	0	7
Columbia.....	0	6	0	0	0	0	0	0	0	6
Worthington.....	0	0	1	0	1	0	0	0	0	2
										654

NOTE: 134 of these are out of use (repairs needed).

In concluding this Report, I beg to acknowledge my indebtedness to your Honorable Body for the kindly and courteous treatment accorded me and my co-laborers in the Construction Department during the term just closing.

Respectfully submitted,

WILLIAM MULHOLLAND,
Superintendent.

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Second Annual Report of the

Board of

Water Commissioners

of the City of Los Angeles, Cal.

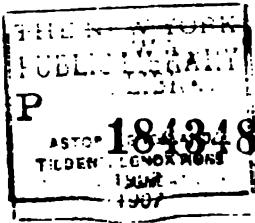
FOR THE YEAR ENDING
NOVEMBER 30, 1903



SECOND ANNUAL REPORT
OF THE
BOARD OF
WATER COMMISSIONERS
OF THE CITY OF LOS ANGELES

FOR THE YEAR ENDING
NOVEMBER 30, 1903

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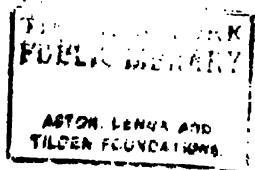


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WM. MULHOLLAND
Superintendent Water Department



ANNUAL REPORT
WATER COMMISSIONERS

FOR THE YEAR
ENDING
NOV. 30, 1903

**FIRST BOARD OF WATER COMMISSIONERS APPOINTED BY
CITY COUNCIL.**

HERMAN SILVER, President.

J. M. ELLIOTT.

L. A. GRANT.

F. W. KING.

H. T. LEE.

C. H. TOLL.

J. C. DRAKE.

PRESENT BOARD APPOINTED BY THE MAYOR.

L. A. GRANT, One Year.

GEN'L M. H. SHERMAN, Two Years.

JNO. J. FAY, JR., Three Years.

WM. MEAD, Four Years.

J. M. ELLIOTT, Four Years.

OFFICERS.

JNO. J. FAY, JR., President.

JAS. P. VROMAN, Secretary.

WM. MULHOLLAND, Superintendent.

L. M. ANDERSON, Auditor.

GEO. D. PESSELL, Water Overseer.

Los Angeles, Cal., December 12, 1903.

To the Honorable Council,

Of the City of Los Angeles:

Gentlemen:—Pursuant to the provisions of Paragraph (K), Article XVIII of the City Charter, the Board of Water Commiss-

sioners respectfully submits its Second Annual Report, being for the fiscal year ending November 30, 1903.

The present board was duly organized on the 5th day of February, 1903, J. J. Fay, Jr., being elected president. Lots were drawn as prescribed in Paragraph (C) of the above Article, by which it was determined that L. A. Grant was to serve one year as Commissioner, M. H. Sherman two years, J. J. Fay, Jr., three years, and J. M. Elliott and William Mead four years each.

Great advantage was found to accrue from the fact that two of the members of the first board, Messrs. Grant and Elliott, were re-appointed to serve on the new, thereby bringing in their valuable experience in the management of the plant through the first and most difficult year of its existence as the property of the municipality.

Too much credit cannot be given to the first board for its wise administration of the affairs of the works as fully demonstrated by the smooth operation of the rules and regulations laid down by it during its term of office, and which it has not been found necessary to change in any essential particular since its retirement.

The total receipts for the year were \$614,264.92, of which \$565,471.96 was for water and the balance for service connections, rents, and material sold.

The total expenditures for the year were \$733,493.13, of which sum \$550,732.04 was for construction, land, etc., \$93,204.76 for operation and maintenance, and \$89,296.33 for bonded indebtedness and interest thereon.

The balance on hand is \$22,926.06 in the various funds as follows: Water Revenue, including Water Deposit Trust Fund.

Details are fully shown in the Report of the Auditor, which follows.

Much progress was made during the year in the carrying out of the plans for the improvement of the works submitted to and adopted by the first board, and fully described in the First Annual Report.

A great deal more might have been accomplished were it not for the urgent demands for extensions of the pipe system due

to the astounding growth of the city, which taxes our resources to the limit.

Of the more important work begun by the old board, that has been accomplished since the last report, might be mentioned the high gravity reservoir, the 7,000,000-gallon pump at the Buena Vista pumping station, the 30-inch main on Alameda street and thence with a 30-inch down Central avenue, the shaft and 1163 feet of the infiltration tunnel and the new extension to the pumping station building now about completed.

The larger features of the new work now in course of construction are the headworks tunnel on the Pomeroy & Hooker land, of which over 2,000 feet is completed; the main conduit leading therefrom which has progressed 19,000 feet and which it is expected to have ready for the delivery of high pressure water into the business section of the city by the first of April next.

Land was purchased for a site for a reservoir to supply the higher levels in lieu of the old Angeleno Heights reservoir, and work is to begin on it at once.

The last remaining lot in the block at the corner of Alameda and Second streets was purchased and a substantial shop and stable, with all other accessories necessary to accommodate the Construction Department, erected on the property.

The policy of metering the supply to consumers, begun by the old board, has been continued with very beneficial results, as the per capita consumption has decreased nearly 15 per cent from that of last year and about 33 per cent from that of 1901.

The importance of this gratifying result is enhanced by the fact that a much greater proportion of the water consumed has to be pumped than formerly.

The meters have also relieved us of the immediate necessity of seeking remote and expensive additions to our water supply which could not be procured without resort to a quite considerable bond issue.

About 41 miles of mains were added to the system during the year, and 4,002 additional taps were made in the same period. It is doubtful if this record was ever exceeded in the annals of

water works construction anywhere. Its mention here is made for the purpose of asking forbearance from our fellow citizens for the many imperfections yet existing in the plant in the way of small mains, etc., and which it has been found impossible to amend as fast as we desire.

A reference to the detailed reports of the Auditor and Superintendent will show more than can be expressed in words, the extraordinary efforts that have to be put forth to keep pace with the growth of this lusty young giant of the West.

The public is greatly inconvenienced by the present location of the office of the Collection Department, and it is sincerely hoped that we will be able within a short time to secure a site more central and suitable to the general public.

The organization has maintained its usual high efficiency which is in a large measure due to the fostering influence of the Civil Service.

The deeding by your honorable body of all the property appurtenant to the Water Department to the Commission, has much facilitated its management, and we beg to express our appreciation of the many courtesies and hearty co-operation of the Mayor and your honorable body, as well as those of the several other Departments of the City Government.

In closing we feel that we must express our great satisfaction as to the general conduct of this business under Superintendent Wm. Mulholland, to whose untiring energy, great ability as an engineer and thorough business methods in management of a large force, the success of municipal ownership of the water works is to be largely attributed.

We also express our thanks to the Auditor and all employees of the Department for efficient and faithful service.

JNO. J. FAY, JR., President.

GEN'L M. H. SHERMAN,

WM. MEAD,

J. M. ELLIOTT,

L. A. GRANT,

Board of Water Commissioners.

Report of the Superintendent



To the Honorable Board of Water Commissioners,
Of the City of Los Angeles:

Gentlemen:—I herewith beg to submit my Report on the operation of the Water Works Department for the year ending November 15, 1903.

The growth of the City of Los Angeles in the fiscal year just closed has in all probability no parallel in the history of any city of its size in the United States.

When agitation first began for the acquirement of the water works by the city, one of the stock arguments of the advocates of the measure was that, notwithstanding the then decadent and inefficient condition of the plant, the revenue would be sufficient not alone to maintain and operate it, but also to make permanent extensions and improvements to keep pace with the growth of the city, as well as meeting the interest and paying off the bonds as they fell due. To use the vernacular of the street, this arrangement is certainly a "pudding" for those owning the vast area of vacant land throughout the city and who contribute nothing towards either the purchase price of the plant or its improvement. There is no doubt, however, that it was on the strength of this implied promise that so large a vote favorable to its purchase was polled.

After nearly two years' possession, and notwithstanding the phenomenal addition of fully 33 per cent to our population in that time as amply evidenced by the number of consumers added to the system, requiring great enlargement and extension of the pipe mileage, as well as additions to the reservoir and pumping capacity, we still continue to meet our obligations as they fall due, and to diligently prosecute the larger work outlined in the plans submitted last year for the comprehensive and permanent improvement of the works.

When it is remembered that the flat rates have been reduced ten per cent and the meter rates fifty per cent in the first year of

its possession by the city, making the rates the lowest of any of the large cities west of the Rocky Mountains, it can at least be claimed that its affairs have been handled in a fairly business-like manner.

It has been a matter requiring the most careful forethought to so plan the construction work under the above conditions as to anticipate the more pressing needs as they were required, leaving that for the future which could best be deferred. So far we have been successful in our efforts, but should our present marvelous rate of growth be much longer maintained, it will tax our resources to the utmost to keep pace with it; especially will this be the case if we are compelled by scantiness of rainfall to resort to expensive expedients for the procurement of more water.

The continued high prices of such material as pipe and fittings constitute a serious drain on our funds, but as it appears to be a fundamental principle in economies that high prices make prosperous times, and we are having at least our share of the prosperity, we cannot justly complain. When it is stated, however, that we have used about 5,700 tons of cast iron pipe and nearly 300 tons of steel in the past year, it will be seen that a difference of eight or ten dollars a ton for those materials makes a great difference in the construction account.

By reference to the tables hereto appended it will be seen that 214,206 feet, or 40.57 miles of mains, ranging in size from 4-inch to 30-inch, have been added to the system during the year.

This great mileage is due in large part to the tendency of the population to scatter over broad areas made accessible by the splendid system of transportation the city enjoys, but it makes it extremely expensive to construct a system of water works that will properly care for all of it, however much rather empty satisfaction we may be able to derive from the fact that we stand about sixth among the cities of the United States in point of area.

Of the forty-three square miles within the city limits, less than ten square miles are occupied, allowing that each tap should serve a space of 50x150 feet, and the streets were all 40 feet wide.

It is respectfully suggested that great care should be exercised in making any further additions to the corporate limits of the



HIGH GRAVITY RESERVOIR FROM UPPER END



city. Such added area should be capable of being supplied from the works of the city as at present designed. It should be remembered to what great expense the city was put in its water works construction by the addition of Garvanza. Since the city acquired the works there has been expended not less than ten times more per capita to properly serve that small addition than was spent on the balance of the city, and the end is not yet, for the Department has still before it the construction of a reservoir and building of a pumping plant especially to serve that small territory, together with additional continual expense of pumping water over 350 feet high for them alone.

The number of service connections made in the year was 4,002. The number made inside the city limits by the West Los Angeles Water Company during the same period was about 1,200, making the total number of connections for the year 5,200. This makes the number on the books of both systems 33,876, and shows a gain of 18.13 per cent for the year. It is usual in cities of the size of Los Angeles to compute the population at about six persons to the tap, but owing to the conditions peculiar to this city which is essentially a city of separate homes and not of tenements, five would be about fair, and using this figure as a factor, our population is found to be in excess of 160,000 at the present time.

There are very few houses marked "vacant" on our books, such as there are being new houses not yet ready for occupancy.

WATER SUPPLY.

Under the head "Los Angeles River" on page 19 of the last Annual Report, much data was given relating to the flow of the stream and the conditions affecting it.

The minimum observed flow of the stream (that of 1902) therein given was $34\frac{3}{4}$ million gallons in 24 hours, but of this amount there was but a little over 29 millions flowing above the diversion works of the system, and hence available for use for domestic purposes.

The statement was made also in the same article that "It is altogether likely that the river flow may continue to diminish

The right of way will be 100 feet wide, 100 feet deep, to be owned by the corporation. The corporation will have the right to use the land as it sees fit. If the abundant water supply is used for irrigation purposes, the corporation will be required to irrigate the various works on the property. The corporation will be required to irrigate 10 million gallons of water per day. The corporation will be required to irrigate 10 million gallons of water per day.

The first group of people to leave the village following the Main
battle were the men who had been sent to the front to engage in and
participate in the fighting. These men were the ones most likely to return. These
men were the ones most likely to be the ones to be left if there
was another battle. The second group to leave was anticipated
to be the women and children. This group included those people who
had been working in the fields. They had to leave in the middle of the day as the tanks
and other military vehicles came through the village. The third group to leave was less useful
and less important. This group consisted of the elderly, the sick, and the infirm. They
left the village in the last days of summer when they could not be
expected to return.

the following day heated
water was available
and the water was taken almost
immediately. The Resin iron
was placed in the water and sulfide in gal-
lons. The water was impelled
through the resin from the

which would give us the security of its nearly 1,000 million gallon capacity to provide for these high peak drafts.

It must be constantly borne in mind that our conditions of water supply are peculiar in that our only present source is the yield from day to day of the watershed of the San Fernando Valley and which is at its lowest ebb when the demands of the system are greatest.

ADDITIONAL SUPPLY.

From the above it will be readily perceived what a narrow margin we had between us and a water famine during the late summer months, but there is no occasion for alarm for the coming year if waste is strictly avoided, as there is a certainty of a production of at least 9 million gallons a day from the developments now nearing completion. These developments consist of water obtainable from the infiltration tunnel above the Buena Vista bridge described in the general report of plans for the improvement of the works submitted last year, and water to be derived from a series of wells now being bored in the river bed a little below the last gravity diversion on the Crystal Springs property.

The tunnel was driven to a distance of 1163 feet last May, at which point work had to be suspended on account of the inability of the temporary pump first installed, to keep it free of water sufficiently to enable further progress to be made. The pump designed to permanently lift the water was completed the first week in October and on trial the yield was found to be in excess of 4½ million gallons daily. It is the intention to continue the driving of this tunnel at least 1,000 feet farther, when its yield is confidently expected to be not less than 7 million gallons.

The wells near the Crystal Springs reached bed rock at about 150 feet, and are bored in fine gravel the whole distance, so it is safe to assume they will jointly yield 2 or 3 million gallons per day, making our total available supply, should we have a rainfall the coming winter sufficient to prevent its further shrinkage, of about 38 million gallons, or sufficient for a population of 100,000 people drawing from the system at the rate of 200 gallons

residence. The city has a total population of about 211,000.
The Atlanta Water Company supplies about 12 per cent of the population.

The company claims in its case that the ultimate attainable supply of water will not exceed at these figures, but simply refers to the time when it will be necessary to pay "an expense not exceeding \$1,000,000" for the present method of making all improvements. It is the present method of making all improvements which is responsible for the over and above operating expenses of the company. It is a system that will call for a supply greater than can be obtained from the Chattahoochee River and the San Joaquin Valley, other sources being exhausted. All that can be done by the expenditure of \$1,000,000 will be to furnish justice to the consumer and to the company, and nothing more.

It is the opinion of the company that through two or three successive years of normal rainfall the emergency can be stayed off until the expense of \$1,000,000 is incurred, when it would be possible to obtain additional supply from the San Joaquin Valley.

It is the opinion of the company that the river for the next twenty years will not be able to furnish a supply known in twenty years time to be normal.

COST OF THE CONSTRUCTION.

ANALYSIS OF COST ON THE TERM.

It is the opinion of the company that the cost of supply, or in other words, the cost of storage or impounding water, is equal to the annual consumption multiplied by the cost of storage. In these cases the cost of storage is the only consideration in the construction of the source of supply, as the costs of





Chicago, Milwaukee, or any of the large lake cities are fair examples of the first instance, as they get their water from the great lakes on which they front, and it is only necessary to provide pumping machinery enough in reserve to meet any extraordinary call to make themselves secure. New York and Boston may be cited as cities relying on a stored supply, and in their cases a temporary draft for a few days or a week at a stretch of even double that of the average consumption would not materially affect or endanger the supply. The to us seemingly paradoxical fact that in many of the Eastern cities the average consumption in winter is as great (or greater during the extreme cold periods) as it is in summer tends to make the above method of computing per capita consumption a fair one.

In our city, however, in the present condition of the works which have only a combined capacity of 65 million gallons in the distributing reservoirs, or little more than a two days' supply during the warm period, the all-year-round method becomes inapplicable to convey the relation of supply and demand. The fact is that in this city for about seven months in the year, beginning with May, the consumption of water attains a fairly constant rate until the beginning of the rainy season, and any excess above that rate that the water shed may be yielding cannot be stored to meet occasional great fluctuations in demand, nor can the surplus flow of the winter months render us any assistance in summer as it would had we an impounding reservoir.

It seems, therefore, that the proper method of computing the per capita consumption for this city, is by dividing the gallons per day consumed during the summer months by the estimated population.

Assuming then that the works of the city is supplying 88 per cent of the population and the consumption for the past six months ran about 30 million gallons per day, then the per capita rate was a little in excess of 200 gallons per day.

All this is perfectly familiar to your honorable body, but for the information of the inquiring citizen who may take interest in the perusal of this Report, these facts should be made plain

and that the department is economy in the use of water and its distribution.

METERS.

The Department is still continuing to apply meters, but unfortunately insufficiency of funds prevents their installation as rapidly as their well proven merit warrants. There is not the slightest doubt but that even the limited number that were in use last summer saved us from a water famine that, had it occurred, could have effectively checked the progress of the city's growth. In fact, the per capita consumption had reached the startling rate of over 100 gallons. Had this kept up (and it was the meters that stopped it) our present needs would be in the neighborhood of 15 million gallons daily, a quantity about 7 million gallons greater than was available last summer. It is interesting to note that this desired result was produced contrary to the predictions of the system's most ardent opponents, without the sacrifice of a single iota of the city's most cherished beauty. In fact, the records will show that in a large majority of cases the annual leakage rate after the meter system has been much less than before metering began. Of course there are a few who still continue the abominable practice of treating grass as though it were a commodity and a source of the equivalent of 8 or 10 inches of rainfall a month, yet not even they seem to discover that their "green grass" always better than ours in 13 or 14-inch appearance.

It was also stated in last year's report that the main line to the high level reservoir would be turned on the first of January, 1902. This was done in April last, and all the difficulties connected with the work were overcome by the change. It was also stated that the piping in most of the older sections of the system was in such a condition as to render absolute replacement necessary at some time. It was also mentioned that the chief difficulty in the waste arising from the system was due to the high head of the pumps. The chief difficulty in the new system, is the high

gravity conduit was completed. Under these circumstances the whole force of the Meter Department has been turned to the work of metering this section, and the benefit of such work is beginning to make itself felt by a notably less draft on the reservoirs at night, it being obvious that heavy all-night consumption is a sure index of waste from leaky fixtures.

It may be stated with absolute conservatism that the twenty-five or thirty thousand dollars the Department has invested in meters has been productive of a saving of water that would have cost the city not less than five hundred thousand dollars to develop and distribute. Surely this result may be considered a sufficient apology for their use if any were needed. A little over 20 per cent of our revenue for water is now derived from the metered services, while but about 5½ per cent of our total services are metered.

ZANJA SYSTEM.

By reference to the Auditor's Report it will be seen that the zanja system has made its usual poor showing for the year. This is not to be wondered at, for the reason that it was only in the lower stream there was any water available for irrigating purposes, as all of the water that was flowing in the main supply ditch had to be taken for the domestic service, and it is a fore-gone conclusion that the days of irrigation from that elevation are past.

The grading and improvement of streets in many instances tore out the zanja pipes, and in a few cases we were asked to restore them, while not a few people through whose property they pass insist on their complete abandonment.

It would certainly be the greatest folly to spend any money in new construction on this system, and the action of the Board in asking that those who desired to use the pipes torn out should restore them at their own expense, was the only proper one.

MAIN SUPPLY CONDUIT.

The building of the main supply conduit from the proposed head works on the Pomeroy & Hooker land near Burbank to this

city has been carried on continuously since June last, about 19,000 feet being completed to date. This work will have to be prosecuted diligently through the coming winter to enable us to reach with its south branch a point in the neighborhood of Alvarado street and Sunset boulevard, from which the main pipe line is to extend down Lake Shore avenue and through the Third street tunnel to supply the business section of the city with high gravity water. When this has been accomplished, work can be suspended on the rest of the line until our financial condition becomes easier.

Extending from the upper end of the main supply conduit a tunnel through the solid granite rock is being driven to cut off the great bend of the river at that point. This tunnel will be 2001 feet long and will enable us to tap the sub-flow of the stream from 20 to 30 feet below its surface.

HEAD WORKS.

On page 24 of the last Annual Report appears the following:

"There are no plans submitted with this report for the head works at the head of the main supply ditch for the reason that a thorough investigation will have to be made by means of borings and otherwise of the bordering rock of the valley at this point before plans can be intelligently prepared.

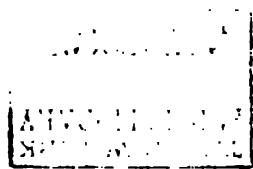
"The need for this preliminary examination will be apparent when it is stated that it might easily involve an additional expense of fifty thousand dollars or more in the construction of these works by the prosecution of a design that did not properly fit the conditions.

"The unsettled state of the Pomeroy & Hooker suit prevents this investigation."

Since then the Pomeroy & Hooker suit has been settled and investigation with a view to the construction of the head works reveals a condition of the rock bordering the stream which is highly favorable to the establishment of an infiltration gallery, which, while it will have some novel features, will be extremely simple of construction and perfectly secure from either contamination of supply or danger from the elements.



MAIN SUPPLY CONDUIT



In the geological description of the San Fernando Valley contained in the last report it was stated that the valley had been filling up for ages with granitic debris carried down from the mountains and that the flood flows had a tendency to hug the southerly and westerly side of the valley. At the point where it is proposed to construct this gallery there is an intrusion of granite which was worn off to a cliff-like face along the stream, which has been gradually buried in the filling-up process. Our tunnel is carried up nearly to the face of this cliff, but as before mentioned, 20 feet below the surface of the stream plane. From this point a gallery in both directions will be driven in the rock as near its face as it will be safe to approach the edge, from which perforated pipes will be driven horizontally out into the gravel and sand.

The rock itself, like all the massive crystalline rocks in this country, is quite fissile, and the shaft now completed permits a leakage of 2 or 3 inches to enter from the stream bed, so that it may reasonably be expected that even without the pipes the gallery will develop a leakage into it of perhaps 4 or 5 gallons per minute to the foot.

At a distance of 2500 feet up stream the gallery will have attained a depth of over 30 feet below the stream, and it is expected the water will by that time have totally disappeared from the surface.

QUALITY OF WATER.

The water obtained by this means will flow by gravity through a closed conduit direct to the consumer, and will compare favorably in quality with the very best water supply enjoyed by any city in the United States.

It may be here stated that after about April, next year, no more water will be taken from the surface flowing stream as by that time means will have been provided to extract the whole supply, pure and sparkling, directly from the gravel.

The Department has installed modern pneumatic tools for the execution of this work, and its total cost will not exceed forty thousand dollars.

INTRODUCTORY

RESOURCES

The following section is designed to give the reader a general idea of the resources available to him in the study of the history of the United States. It is not intended to be exhaustive, but rather to point out the more important sources of information. The reader is referred to the bibliographies at the end of each chapter for a more detailed treatment of the subject.

THE LIBRARIES

The following list of libraries includes some of the most important collections of historical material in the United States. The reader is referred to the bibliographies at the end of each chapter for a more detailed treatment of the subject.

THE LIBRARIES

AMERICAN
UNIVERSITY
LIBRARY

It is to be hoped that at an early date the Collection Department can be moved to more eligible and commodious quarters than those now occupied, which are undesirable from every point of view.

The operation of Civil Service Rules has enabled us to retain undisturbed the organization of trained employees whose experience was gathered under the scrutinizing management of the old Water Company, and such employees as have been added since owe their position to their own ability in passing the necessary qualifying examination of the Civil Service Commission.

The appended tables give a complete statement of the additions to the various features of the distributing system since November 15, 1902.

**STATEMENT OF PIPE LAID DURING THE YEAR ENDING
NOVEMBER 15, 1903.**

	Length feet	Size inches
Avenue 29 at Pasadena.....	78	16
Pasadena, Avenue 29 to Avenue 61	7856	12
Pasadena, Avenue 63 to Avenue 66.....	922	4
Sixteenth street, Main to Santee.....	1139	6
Avenue 30, between Pasadena and Humboldt.....	2088	4
Eighteenth, between Union and Cherry	1645	6
Stephenson street west of Alameda.....	2136	10
Alameda street, College to Stephenson.....	6143	36
Alameda street, Stephenson to Third.....	525	30
Alameda street, south of Seventh	862	10
Avenue 28, between Pasadena and Griffin Avenues ..	770	12
Avenue 29, west of Montecito	502	4
Washington street, between Naomi and Central.....	896	6
Avenue 50, west of Pasadena	954	4
Avenue 52 at Pasadena	76	4
Avenue 54 at Pasadena.....	111	4
Avenue 56 at Pasadena	69	4
Avenue 57 at Pasadena.....	69	4
Burlington avenue, between Sixth and Ninth	1329	6
Main street at Third.....	116	16
Main street, south of Thirty-seventh	3100	4
Main street, between Griffin and Eastlake	1188	6
Main street, Eastlake to Gates	361	4

	Length feet	Size inches
Beacon street, Seventh and Ninth.....	1244	4
Ninth street, west of Hoover	586	4
Baldwin street, east of Griffin.....	1206	6
Darwin, between Griffin and Douillard	2956	6
Los Angeles River, Pump Station to Macy street.....	8696	16
Los Angeles River, Pump Station, east	195	20
Fifty-first street, east of Central	1305	4
Fifty-first street, west of Central.....	1316	4
Weatlake avenue, between Seventh and Ninth.....	1237	4
Figueria street, from high service reservoir to Ramona street	1332	16
Figueria street, Third to Orange.....	2451	12
Figueria street, Beaudry avenue to high service reservoir	596	11
Beaudry avenue and around high service reservoir.....	1394	4
Beaudry avenue at Alpine.....	16	6
Beaudry avenue, north of Figueria	146	11
Third street, Figueria and east	20	4
Third street at Lucas	39	4
Third street at Garey and east.....	336	4
Third street at Santa Fe and west.....	423	4
Third street, east of Central.....	62	6
Third street, Main to Los Angeles	483	12
Third street, Main to Broadway.....	839	16
Third street, Broadway to Figueria.....	2566	18
Third street, Alameda to Central.....	500	30
Maple Avenue, south of Thirty-eighth	1006	4
Pollard street to Garvanza high service reservoir.....	594	6
Pollard street, between Avenue 64 and Avenue 65.....	345	6
Avenue 64, north of Pasadena.....	235	4
Avenue 64, between Pasadena and Pollard	2075	6
Elgin street, between Avenue 63 and Avenue 64.....	52	4
Elgin, between Avenue 63 and Avenue 64	325	6
Twenty-second street, between Naomi and Trinity	1594	4
Twenty-first street, between San Pedro and Hooper.....	2251	4
Twenty-first street, between Main and Figueria	2537	4
Twenty-third street, between Central and Hooper.....	2546	4
San Pedro street, Thirtieth to Thirty-third street.....	878	4
Thirty-first street, between San Pedro and Griffith Avenue	1259	4
Thirty-second street, between Central and Griffith Avenues	1358	4
Thirty-third street, between San Pedro and Wadsworth ...	2636	4
Broadway, between Third street and south of Fourth	384	16
Central avenue, Fifty-fourth to Fifty-seventh street.....	1312	6
Central avenue, Third to Seventh.....	3491	30
Central avenue, Seventh to Ninth.....	2292	24

	Length feet	Size inches
Alpine street, Beaudry to Figueroa.....	1486	6
Marchessault street, between Los Angeles and New High.	17	4
Marchessault street, between Los Angeles and New High.	22	12
Marchessault street, between Los Angeles and New High.	663	16
Bellevue avenue, Grand to Hill street	234	6
Bellevue avenue, Grand to Figueroa.....	1098	8
New High, between Temple and Marchessault	775	18
Hill street, Bellevue to California.....	1387	6
Los Angeles street, Alameda to Marchessault	221	18
Sixth street, Lucas and west.....	3036	10
Sixth street, east of Alameda	1722	6
Sixth street, east of Lucas	546	4
Centennial street, between Boston and Court Circle	913	4
Alley between Crescent avenue and Eaglerock	900	10
Fourth street, from Boyle avenue to Soto	2564	8
Eaglerock avenue, Latrobe and east.....	278	10
Latrobe street, between Eaglerock and Pasadena.....	380	10
Fourth street, from Glass street to Clarence.....	266	4
Fourth street at Lucas.....	38	4
Fourth street, Evergreen avenue to Euclid street.....	376	6
Fourth street, San Pedro to Central.....	1240	6
Fourth street, Main to Los Angeles.....	393	6
Macy street, River to Pleasant avenue	1434	16
Macy street, at Alameda	47	12
Belmont avenue, between Bellevue and Kane street	359	4
Belmont avenue, Temple to Bellevue....	916	8
Temple street, Flower to Bunker Hill avenue	642	10
Temple street, Edgeware Road to east of Metcalf.....	389	4
Temple street at Figueroa.....	62	12
Bush street, Pico to Sixteenth.....	1269	4
Lake street, between Seventh and Pico.....	1475	4
Eleventh street, between Grand View and Park View... .	675	4
Glass street, First street to south of Fifth	2836	4
Fifty-sixth street, between Central and McKinley.....	1243	4
Grand View avenue, between Eleventh and Twelfth.....	489	4
Grand avenue, between Alpine and Bellevue	1139	4
Boyle avenue, Fourth street to Sixth.....	948	8
Boyle avenue, First street to Fourth	1555	10
Girard street, west of Georgia.....	441	4
Bunker Hill avenue, south of Temple	358	4
Griffin avenue, Avenue 28 to Altura	369	8
Orange street, west of Figueroa.....	734	12
Avenue 66, between Elgin and Pasadena	1448	4
Crescent, between Avenue 66 and Latrobe	140	10

	Length feet	Size inches
Soto street at Second street	106	6
San Fernando street at College and north	119	22
San Fernando street at College and north	22	36
San Fernando street, Alpine to College street	490	6
College street, San Fernando to Buena Vista	475	22
College street at San Fernando	17	6
Sunset boulevard at Echo Park Road	11	4
Sunset boulevard, between Micheltoreno and Lucile.....	1672	4
Sunset boulevard, between Micheltoreno and Phillio	3435	6
Sunset boulevard, between Lake Shore and Phillio.....	3471	8
Avenue 22, Pasadena to Humboldt	1250	4
Alvarado street, Ninth to Pico street.....	2502	6
Johnston street, north of Downey avenue	373	4
Bandini street, Sunset boulevard to Marathon	447	4
Marathon avenue, east and west of Stanislaus.....	564	4
Eastlake avenue, north of Baldwin.....	277	4
Arnold street, Lucas to Bixel street	603	6
Hubbard street at Marathon	14	4
Avenue 37, Arroyo Seco to Pasadena.....	262	4
Arroyo Seco avenue, Avenue 37 to south of Amabel street	1115	4
Gillette, south of West End street.....	393	4
Cornwell street, Brooklyn to Sheridan	1279	4
Mitchell Place at Gillette street.....	38	4
Bond street, Fourteenth to Sixteenth street.....	653	4
Albany street at Sixteenth.....	79	4
Rich street, between Fourteenth and Sixteenth streets.....	653	4
New York street, Pasadena avenue to Mesa street.....	1240	4
Kip street, Orange to Ingraham street	163	4
Ingraham street, Kip street to Little street.....	3577	4
Temple Road, Temple street to Fanning street.....	1471	4
Tenth street, Figueroa to Georgia.....	930	4
Tenth street, Union avenue to Georgia.....	2400	4
Euclid avenue, Fourth street to Sixth	1304	6
Albion street, Newell street to Avenue 18.....	704	4
Wright street, Pico to Sixteenth street.....	1313	4
Monte Vista street at Avenue 50.....	40	4
Kensington Road, Douglas street to Marion avenue	1797	4
Seventeenth street, Union avenue to Figueroa.....	3110	4
Avenue 63 at Pasadena	75	4
Avenue 60 at Monte Vista.....	39	4
Santee street, from Twelfth to Pico	506	4
Santee street, from Sixteenth to Seventeenth street	406	4
Santee street, from Twenty-first street to Washington	1537	4
Hope street, Sixteenth to Washington street	1245	4

SECOND ANNUAL REPORT

	Length feet	Size inches
Thirty-fourth street, San Pedro to South Park avenue.....	1412	4
Twenty-third avenue, Thirty-third street to "F" street	2335	4
Thirty-third street, San Pedro street to South Park avenue	2086	4
Twenty-third avenue, Thirty-third to Fifty-fourth street	327	4
Thirty-second street, east of Waldrich street	426	4
Avenue 14, Marandela avenue to Humboldt	954	16

SUMMARY.

1st st.	.... 103,076 feet.
2nd st.	.... 34,435 feet.
3rd st.	.... 4,406 feet.
4th st.	.... 12,694 feet.
5th st.	.... 742 feet.
6th st.	.... 19,848 feet.
7th st.	.... 14,879 feet.
8th st.	.... 3,562 feet.
9th st.	.... 195 feet.
10th st.	.... 594 feet.
11th st.	.... 4,104 feet.
12th st.	.... 4,510 feet.
13th st.	.... 9,165 feet.
Total	214,206 feet—40.57 miles

FIRE HYDRANTS.

Fire Hydrants in System, November 15, 1902.....	660
Single Fire Hydrants placed during the year ending November 15, 1903.....	30
Double Fire Hydrants placed during the year ending November 15, 1903.....	32
Total Fire Hydrants in System	722

SERVICES.

Services in System November 15, 1902.....	26,076
Services added during the year ending November 15, 1903.....	4,002
Total Services.....	30,078

SERVICES BY WARDS.

Put in during the year ending November 15, 1903 :

Size	1	2	3	4	5	6	7	8	9	Total
5 ¹ / ₂ -in.	341	222	70	116	103	1163	121	52	314.....	2502
6 ¹ / ₂ -in.	184	72	91	344	54	309	78	10	109.....	1251
1 -in.	17	12	29	50	10	16	22	6	7.....	169
1 ¹ / ₂ -in.	0	1	4	1	0	1	1	0	0.....	8
2 -in.	1	2	16	2	0	2	6	2	1.....	32
3 -in.	0	0	1	2	0	0	1	0	0.....	4
4 -in.	0	0	0	0	0	0	3	0	0.....	3
	543	309	211	515	167	1491	232	70	431.....	3969
Not located									33	
										4002

GATES.

Placed during the year ending November 15, 1903 :

4-in.....	45
6-in.....	30
8-in.....	15
10-in.....	11
12-in.....	22
16-in.....	8
18-in.....	1
20-in.....	1
22-in.....	1
24-in.....	3
30-in.....	2
36-in.....	1
Total	140

METERS**Set During Year Ending November 15, 1903.**

SIZE	November 15, 1902	November 15, 1903	INCREASE
$\frac{1}{2}$ -inch	2	2	0
$\frac{5}{8}$ -inch	529	812	283
$\frac{3}{4}$ -inch	248	453	205
1 -inch	115	205	90
$1\frac{1}{2}$ -inch	0	20	20
2 -inch	64	87	23
3 -inch	9	14	5
4 -inch	3	6	3
6 -inch	0	2	2
 City.....	 970	 1,601	 631
 $\frac{1}{2}$ -inch	 0	 0	 0
$\frac{5}{8}$ -inch.....	19	82	63
$\frac{3}{4}$ -inch	7	19	12
1 -inch	10	20	10
$1\frac{1}{2}$ -inch	0	2	2
2 -inch	0	1	1
3 -inch	0	0	0
4 -inch	0	1	1
 Private	 36	 125	 89

Meters placed during year..... 720

Total meters in use 1,726

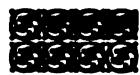
Thanking your honorable body, both for myself and my fellow workers in the Department, for the kindly encouragement and generous treatment accorded us, the above is respectfully submitted.

WM. MULHOLLAND,
Superintendent.



HIGH GRAVITY RESERVOIR FROM LOWER END

Report of Department Auditor



Los Angeles, Cal., December 1, 1903.

To the Honorable Board of Water Commissioners,

Of the City of Los Angeles, California:

Gentlemen:—I herewith submit my second Annual Report showing the financial operations of the Water Department for the year ending November 30, 1903.

RECEIPTS.

Balance by Last Report	\$142,154.27
Water	\$540,008.50
Permits	9,753.02
Service Connections	42,181.35
Material and Labor	4,222.36
Rents	0.00
Meters Sold	1,272.00
Zanja Department	5,800.75
Old Buildings Sold	485.00
Meter Deposits	330.00
Uncalled for Emergency Demands	209.25
	<hr/>
	\$144,264.92
	<hr/>
	\$750,419.19

DISBURSEMENTS.

General Construction	\$377,378.73
Main Supply Conduit	78,200.00
Infiltration Gallery	14,200.75
Reservoirs	10,440.45
Head Works	17,008.53
Maintenance	5,035.00
Operating	72,104.51
Meters	6,528.04
Land and Buildings	43,734.98
Zanjas	8,537.15
Transfer to Int. and Sinking Fund	80,200.33
Meter Deposits returned	200.00
Deposit with Street Supt.....	1,000.00
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	733,493.13
Balance on hand Dec. 1, 1903	\$ 22,029.46

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DISBURSEMENTS BY MONTHS.

December, 1902.

	Labor	Material	Sundries	Total
General Construction.....	\$7,655.00	\$18,248.25	\$.....	\$25,903.91
Infiltration Gallery.....	745.25	152.15	.....	897.40
Reservoirs.....	2,341.51	17.00	.....	2,358.51
Maintenance.....	218.10	83.12	.....	301.22
Operating.....	4,510.92	1,298.69	.....	5,809.61
Lands and Buildings.....	.....	14,850.00	.....	14,850.00
Deposits Returned.....	.....	.....	40.00	40.00
				\$50,160.65

January, 1903.

General Construction.....	\$8,362.46	\$14,391.45	\$.....	\$22,753.91
Infiltration Gallery.....	712.50	115.50	.....	828.00
Reservoirs.....	2,492.99	.....	.....	2,492.99
Maintenance.....	243.95	129.29	.....	413.24
Operating.....	4,035.92	1,537.60	.....	5,573.52
Deposits Returned.....	.....	.....	10.00	10.00
				\$32,071.81

February, 1903.

General Construction.....	\$8,775.91	\$41,203.27	\$.....	\$49,979.18
Infiltration Gallery.....	1,056.10	187.39	.....	1,243.49
Reservoirs.....	1,464.24	857.68	.....	2,321.92
Maintenance.....	290.00	184.78	.....	474.78
Operating.....	3,986.12	1,563.20	.....	5,551.32
Meters.....	.....	60.00	.....	60.00
Zanjas.....	410.00	5.51	.....	415.51
To Interest and Sinking Fund.....	.....	.....	9,267.77	9,267.77
Deposits Returned.....	.....	.....	30.00	30.00
				\$69,133.97

DISBURSEMENTS BY MONTHS—Continued.

March, 1903.

	Labor	Material	Sundries	Total
General Construction.....	\$8,954.91	\$17,912.28	\$.....	\$26,867.19
Infiltration Gallery.....	1,115.50	257.62	.....	1,373.12
Reservoirs	1,744.00	2,010.62	.....	3,754.62
Maintenance	246.75	27.28	.....	274.03
Operating	3,817.17	1,130.74	.....	4,947.91
Lands and Buildings .....	.....	182.83	.....	182.83
Zanjas.....	563.00	13.67	.....	576.67
Deposits Returned .....	.....	.....	10.00	10.00
				\$37,986.37

April, 1903.

General Construction.....	\$10,036.96	\$74,776.46	\$.....	\$84,813.42
Conduit	389.10	.63	.....	389.73
Infiltration Gallery	807.50	279.69	.....	1,087.19
Reservoirs	2,746.80	1,841.18	.....	4,587.98
Maintenance	264.90	78.81	.....	343.71
Operating	4,084.67	908.80	.....	5,053.47
Meters .....	.....	156.50	.....	156.50
Lands and Buildings .....	.....	368.82	.....	368.82
Zanjas	1,017.00	.....	.....	1,017.00
				\$97,817.82

May, 1903.

General Construction.....	\$8,545.40	\$30,078.11	\$.....	\$38,623.51
Conduit.....	4,422.30	2,167.66	.....	6,589.96
Infiltration Gallery.....	1,123.25	104.14	.....	1,227.39
Reservoirs	1,067.50	1,126.02	.....	2,783.52
Maintenance	283.90	68.30	.....	352.20
Operating	4,288.20	1,179.57	65.10	5,502.87
Meters .....	.....	5.70	.....	5.70
Lands and Buildings.....	.....	4,025.00	.....	4,025.00
Zanjas.....	1,169.00	5.25	.....	1,174.25
Deposits Returned.....	.....	.....	50.00	50.00
Street Department.....	.....	.....	1,000.00	1,000.00
				\$61,334.40

DISBURSEMENTS BY MONTHS—Continued.

June, 1903.

	Labor	Material	Sundries	Total
General Construction.....	\$9,428.55	\$15,326.64	\$.....	\$24,755.19
Conduit.....	6,546.90	7,062.93	.....	13,609.83
Infiltration Gallery.....	1,313.45	768.23	.....	2,081.68
Reservoirs.....	656.25	60.66	.....	716.91
Maintenance.....	312.85	112.77	.....	425.62
Operating.....	4,350.15	1,041.68	175.00	5,566.83
Meters.....	.....	60.00	.....	60.00
Lands and Buildings.....	.....	3,000.00	.....	3,000.00
Zanjas.....	1,229.75	452.22	.....	1,681.97
Deposits Returned.....	.....	30.00	.....	30.00
				\$51,928.03

July, 1903.

General Construction.....	\$9,029.45	\$18,337.05	\$.....	\$27,346.50
Conduit.....	6,836.60	3,270.16	.....	10,106.76
Infiltration Gallery.....	954.25	1,016.13	.....	1,970.38
Reservoirs.....	313.50	.....	.....	313.50
Head Works.....	607.90	.....	.....	607.90
Maintenance.....	311.82	42.80	.....	354.62
Operating.....	4,685.50	1,512.04	68.45	6,266.04
Meters.....	.....	163.92	.....	163.92
Lands and Buildings.....	.....	3,125.00	.....	3,125.00
Zanjas.....	734.00	9.49	.....	743.49
				\$51,018.11

August, 1903.

General Construction.....	\$6,701.45	\$3,836.67	\$.....	\$10,538.12
Conduit.....	6,405.85	4,559.95	.....	10,965.80
Infiltration Gallery.....	689.60	867.02	.....	1,556.62
Reservoirs.....	119.50	.....	.....	119.50
Head Works.....	1,432.25	2,848.79	.....	4,321.04
Maintenance.....	274.35	126.46	.....	401.31
Operating.....	5,252.90	1,295.60	59.00	6,607.59
Meters.....	.....	861.55	.....	861.55
Lands and Buildings.....	.....	10,119.38	.....	10,119.38
Zanjas.....	768.00	27.63	.....	795.63
Transfer to Interest and Sinking Fund.....	.....	.....	80,028.56	80,028.56
Deposits Returned.....	.....	10.00	.....	10.00
				\$126,325.10

ANNUAL STATEMENT REPORT

REPRESENTS BY MONTES—Continued.

અનુભૂતિકર. ૩૦૧

Amount	Debit	Credit	Total
6,145.47	32,374.85		38,520.32
17.45	1,114.71		1,132.16
11.00	139.44		150.44
44.00	44.00		88.00
20.00	35.00		55.00
241.10	1,171.00	1,070.00	1,143.00
	1,571.55		1,557.55
100.00	100.00		200.00
		40.00	40.00
			555,772.02

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Period	Actual	Budget	Variance
Jan	12,000	12,000	\$0.00
Feb	12,000	12,000	\$0.00
Mar	12,000	12,000	\$0.00
Apr	12,000	12,000	\$0.00
May	12,000	12,000	\$0.00
June	12,000	12,000	\$0.00
July	12,000	12,000	\$0.00
Aug	12,000	12,000	\$0.00
Sept	12,000	12,000	\$0.00
Oct	12,000	12,000	\$0.00
Nov	12,000	12,000	\$0.00
Dec	12,000	12,000	\$0.00

SCHOLASTIC TESTS

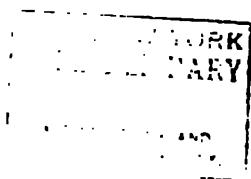
Before closing this Report, I wish to call the attention of the board to the insufficient office accommodations for handling the business of the Department, which has grown to large proportions.

The public complains bitterly of our location, not only of the location, but on account of the undesirable neighborhood.

I wish to thank the board and its officers for their unqualified support and confidence in all matters pertaining to the operation of the Water Department.

L. M. ANDERSON,
Auditor.



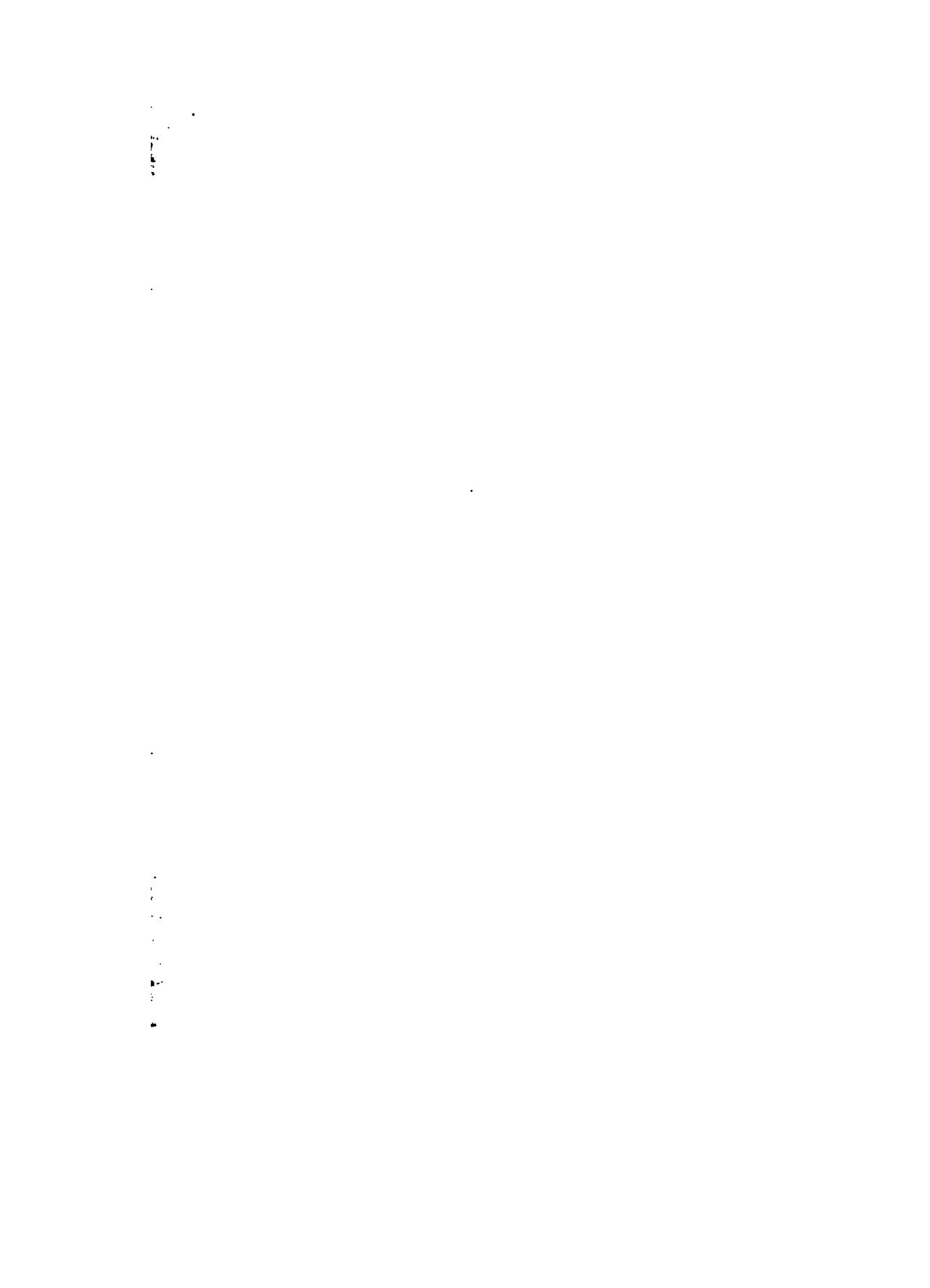


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Third Annual Report of the
Board of
Water Commissioners
of the City of Los Angeles,
California

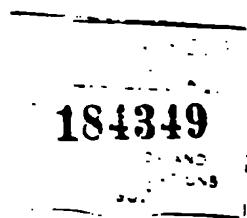
FOR THE YEAR ENDING
NOVEMBER 30, 1904





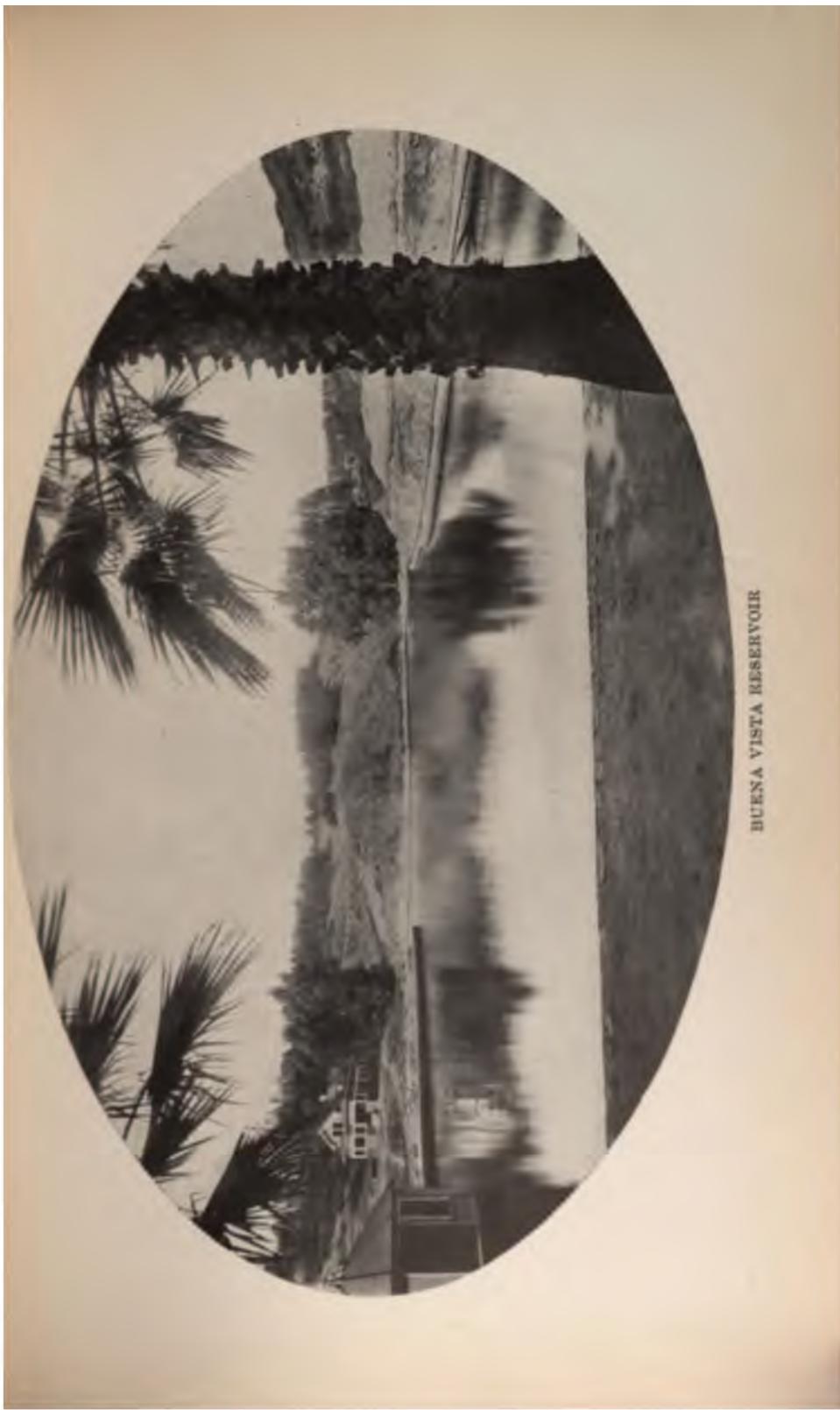
THIRD ANNUAL REPORT
OF THE
BOARD OF
WATER COMMISSIONERS
OF THE CITY OF LOS ANGELES
FOR THE YEAR ENDING
NOVEMBER 30, 1904

GEO. RICE & SONS, (INC.) PRINTERS
LOS ANGELES

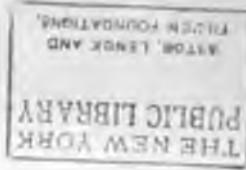


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BUENA VISTA RESERVOIR





BOARD OF WATER COMMISSIONERS

L. A. GRANT
GEN'L M. H. SHERMAN
JNO. J. FAY, JR.
WM. MEAD
J. M. ELLIOTT

OFFICERS

JNO. J. FAY, JR., President
JAS. P. VROMAN, Secretary
WM. MULHOLLAND, Superintendent
L. M. ANDERSON, Auditor

To the Honorable Council,
Of The City of Los Angeles,

Gentlemen:—In submitting this the Third Annual Report of the Board of Water Commissioners, being for the fiscal year ending November 30th, 1904, it is only necessary to call attention to the fact that 5145 consumers were added during the year to those already supplied by the system, to show the extreme effort that had to be made to keep pace with the phenomenal growth of the city. When we add to this the fact that 37.63 miles of street mains had to be laid, and two distributing reservoirs built within the fiscal year as well as large additions to the pumping equipment, together with 16 12-inch wells besides the plants to operate them, it will be seen why the revenue of the Department, great as it may seem, was taxed to the limit to cover the unusually pressing expenditures.

Owing to the rapid development of that portion of the City supplied by the West Los Angeles Water Company, agitation was begun towards the close of last year by those residents of that district who were aware of the inadequacy of that Company's plant to meet their growing needs, to have the city purchase their works and connect them with the main system. With the approval of your Honorable Body, negotiations were begun with that end in view, and a careful appraisement made of the cost of the works. The figures of this appraisement, namely \$503,000, were found to agree very closely with what the books of the concern showed the works to have cost, but after making all due allowance for the depreciation and eliminating certain portions of the works which would prove of no value to the City a settlement was reached by which the Company agreed to accept \$337,500, in full payment for the works, also agreeing to acknowledge judgment in the City's suit against them to restrain them from taking water from the San

Fernando Valley. This suit had already been tried in the Supreme Court of the State, and decided in favor of the City, but an appeal from the judgment was in preparation. A further consideration in the deal was that the City should deliver to the Company for a period not to exceed three years, water at the rate of not to exceed 2 million gallons daily in their Franklin Avenue Reservoir in exchange for which the Company agrees to pump a like amount into the City's mains from its Jefferson Street Pumping Station.

This arrangement was found to be mutually advantageous by reason of the obviation of the immediate necessity of laying expensive lines of pipe that each would otherwise have to construct.

The proposition of issuing bonds for the purchase of these works on the above basis, was ratified by the people, as well as the issue of \$150,000, for the acquirement of land, and construction of a reservoir thereon at Ivanhoe. The West Los Angeles Water Company was duly paid off by the proceeds of the sale of the bonds issued for the purchase of their works, but the issue for the reservoir still remains unsold although we have had to draw on the regular revenue of the Department to pay for the land, and to meet part of the cost of the main conduit constructed to deliver into the reservoir.

The question of water supply owing to the lack of rainfall of last winter, following the great average deficiency of the past ten years, has reached an acute stage, as will be seen by reference to the Superintendent's report thereon hereto appended. This condition is further aggravated by the fact that the supply afforded by the San Fernando Watershed is being greatly diminished by the pumping plants in the valley recently installed by the farmers.

THE SAN FERNANDO WATER CASE.

The controlling factor, and in fact almost the sole reason for the existence of the City of Los Angeles in its present loca-

tion, was the never failing flow of the Los Angeles River. Without it there would have been no Los Angeles, either in its past condition as a prosperous Pueblo, with its surrounding productive agricultural settlement, or its present one as a busy modern city.

With the exception of a small quantity formerly used on the Rancho Los Feliz, the right to which was bought by the City seventeen or eighteen years ago, the city has always controlled whatever of the stream was required for the use of her inhabitants, which was generally all of it. In any case, whenever there was an excess, such as there was in the years 1891-2 and 3, it was used by landowners below the city.

The Los Angeles river, like all the streams that afford a constant flow in this country and are not merely intermittent flood streams, receives its supply from the great gravel deposits of the valley in which it has its source, which is charged at irregular intervals by the flood waters of the surrounding mountains. If there were no such medium for storage purposes as this gravel affords there would be no Los Angeles river, as the water would flow off in great volume to the sea within a few days of its precipitation on the drainage area.

In the portion of the San Fernando Valley overlying these great gravel deposits from which the river derives its water, there is much fertile land that has been farmed successfully for many years without irrigation, and over by far the greater portion of it there has as yet been no attempt made at irrigation. The owners of this land never made the semblance of a claim to a single drop of the water of the river, but a few years ago some of them sank wells and began pumping water extensively for irrigation.

The effect of this pumping has been very marked on the flow of the river, and we recognize the fact that if the practice were to become general all over that portion of the valley in which this water is stored, the city would in a short time be deprived of its entire water supply, for it must be apparent that if those now pumping have a right to do so, then all the others have

the same right. With this alarming contingency staring it in the face, this Board thought it proper to take the matter to the Courts for a determination of the city's rights, it being manifestly to the interest of both parties to the controversy that their rights should be legally determined at as early a date as possible.

The City of San Francisco has recently developed a scheme for the procurement of a water supply of sixty million gallons daily from the Tuolumne river, which it is estimated will cost \$30,724,000 to bring it to the city exclusive of \$8,807,000 for the distributing works inside the city. The distance this water is to be brought is about 125 miles.

The City of Los Angeles consumes more water than San Francisco and is not so favorably situated in point of either distance or engineering difficulties necessary to be surmounted to reach a reliable source as her big sister on the bay, besides which we know of no reliable streams within reasonable distance of this city that remain unappropriated, so that we will have to add the cost of purchasing such water to the expense of bringing it here.

It may be here stated that no feasible project has as yet been presented to this Board in a sufficiently tangible state to enable even a guess to be made as to the cost of replacing the water of the San Fernando Valley with another supply, but it is a safe assumption that the figures will prove a rather appalling total to the taxpayer when submitted.

The absurdity of the proposition of withdrawing the suit and abandoning the water altogether must be evident to all, when it is remembered that this city has been using it and has had control of it for over one hundred years, as against the not to exceed an average of four years' use by the defendants in this case.

It has been suggested that great quantities of water might be obtained from wells driven in the river bed above the city, but this has been tried with the result that the river flow was diminished within a few days by exactly the amount pumped from the wells, the effort was discontinued, to be resorted to

only when by reason of flood the river water was in a turbid condition.

The lesson derived from the showing of these wells and pumps is a conclusive refutation of the ridiculous claim so often asserted, that raising the water from below increases the total yield of the water shed.

No doubt a series of wet winters would serve to restore the yield of the valley to its former condition, but we know from past observation and computations of the enormously depleted condition of the gravels, that the process will be a slow one, and as we have no assurance that the pumping from them will not be largely extended should the court decide that the irrigators are within their rights in using the water, the sooner a decision is had in the matter the better it will be for all concerned.

The amount of water used by the irrigators in the San Fernando valley has been estimated to be 984 miners inches for six months of the year, which is equal to 6,376,000 gallons daily for the whole year, or about sufficient at the present rate of consumption in the city, to supply a population of 32,000 people at maximum summer needs, or about 50,000 people at the average full year rate.

Should the court decree the restoration of this quantity to the city's supply, the necessity for seeking a new and remote one can be put off for many years by the addition of the small quantities that may be temporarily produced from wells in the open plain south of the city.

In all of the many suits concerning the ownership of the waters of the Los Angeles river, it has invariably been held that the city's right was paramount, and this Board feels that it would be justly held to be recreant to its duty should it longer permit without resistance the commission of an act that so manifestly and certainly reduces the flow of the stream and the water supply of the city."

A review of the financial statement of the Auditor shows the total receipts of the Department for the year to have been \$772,978.32, an increase of \$158,713.40, or nearly 20 per cent,

and the first part - about \$60,000 of this was due to the addition of the West Side and the Water Works plant, but even so, I believe this amount we have a natural increase of population and water - which is wholly due to the growth and development of our city over a single year.

The total cost \$88,000 expended in the permanent enlargement of the present works, including the purchase of land, labor, and materials.

The sum of \$80,000 was paid out of the City Treasury on account of the new Water Works bonds, and \$97,000 for the construction of tanks falling due during the ensuing year.

At your request I will now refer your Honorable Body to the financial statement of the Water Works bonds, and to the detailed statement of Receipts and Expenditures in the Auditor's report for a more full account of the financial transactions of the department for the year just closed.

In the discharge of his duty, Mr. Grant, whose term expired last February, the members of the Board remained the same as last year.

The successful management of the Water Works in all practical respects and the execution of the many improvements undertaken and completed during the year, should be credited to Mr. George D. Bellard, Superintendent, who has been assiduous and diligent and constantly there for the good of the Department, and his assistants with the same characteristics.

To Mr. Anderson, Captain, and his efficient and hard-working corps of assistants, is my full recognition for the success and conduct of the business affairs of the Water Works.

I would express my thanks to the Mayor and to your Honorable Body for their kind interest in the other Departments of the City, and particularly the Fire Department.

J. HENRY FAY, JR., President.

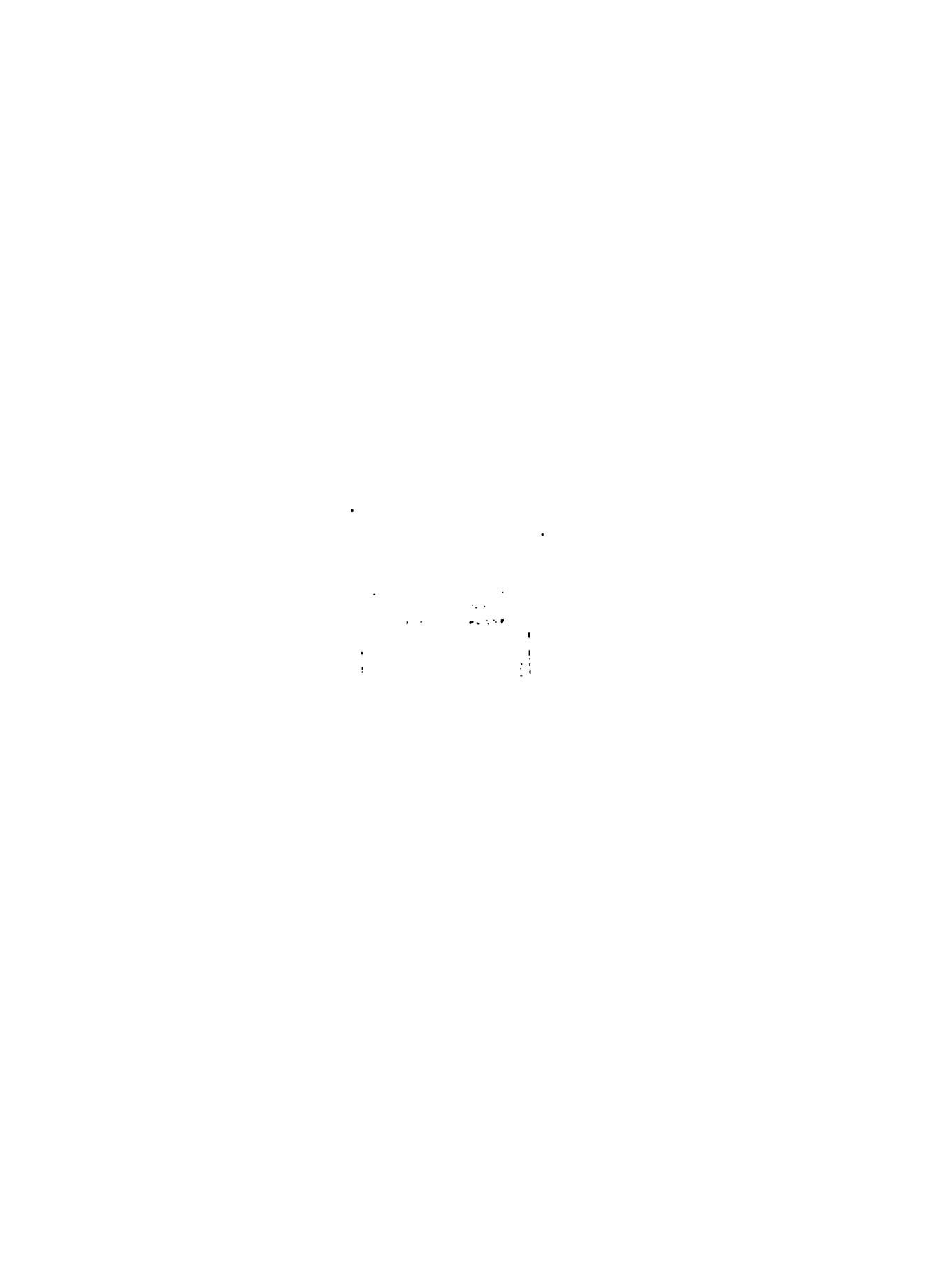
J. M. ELLIOTT,

J. H. SHERMAN,

Board of Water Commissioners.



HIGH SERVICE RESERVOIR (INCOMPLETE)



Report of the Superintendent



To the Honorable Board of Water Commissioners
Of the City of Los Angeles:

Gentlemen:—In accordance with the requirements of the Department, I beg to submit my Annual Report on the work accomplished in the fiscal year just closed, together with an account of the condition of the works and such suggestions for their improvement as appear necessary, or, more strictly speaking, urgent, for, as is well known to you, so rapid has been the city's growth that it has been as much as the resources of the Department could do to provide for the bare needs of the great influx of population that has come to our city in the past three years.

WEST SIDE PURCHASE.

The most important event of the year was the acquirement by purchase of the West Los Angeles Water Company's works, which supplied all that portion of the city lying west of Hoover street. This added 26.65 miles of mains to the system, ranging in size from four inches to twelve inches in diameter and supplying 4335 taps.

The growth of the section supplied by this system has only been surpassed by that of the Sixth ward in the past year, and it required vigorous work on our part to obviate a water famine there, coming as it did into our possession at the very beginning of the heated term. There still remains much heavy and expensive work to be done in that region to properly serve it, as from the nature of the improvements being made it will require a high rate of consumption to maintain it in the ambitiously ornate manner in which it is being developed.

The purchase, however, has been justified by the handsome revenue derived therefrom, which at present is in the neighborhood of \$100,000 per annum.

MAIN CONDUIT.

The main conduit from the Pomeroy and Hooker land has been completed to the site of the proposed storage reservoir at Ivanhoe, a distance of 28,927 feet, and is now delivering water by gravity into a twenty-four-inch main leading to the business section of the city. The building of this main enabled us to nearly double the pressure over that supplied from the Buena Vista reservoir, its head being nearly 70 feet greater. This increase of pressure developed many weak places in what was left of the old pipe system, in spite of the many precautions taken in anticipation of such result. The damage accruing therefrom was slight to the Department, however, but proved disastrous to much of the old plumbing in the city, which may be regarded as not wholly an evil, as it compelled renewal of many worn out fixtures that would otherwise have been permitted to remain in a state of drooling senility and wastefulness.

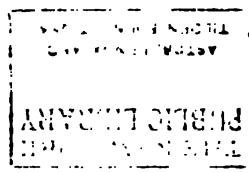
HIGH SERVICE RESERVOIR.

A new concrete lined reservoir of nearly seven million gallons capacity has been built on the site purchased from Alfred Solano near Plyman Park. This reservoir takes the place of the old Angelone reservoir, which has been abandoned. The Buena Vista reservoir is nearly superfluous, being now served by gravity from the new conduit, and the higher ground placed under the high service reservoir as contemplated in the general plans of ten or twelve years ago.

These changes should meet the coming situation of all our



HIGH SERVICE RESERVOIR (INCOMPLETE)



main pump equipage at the Buena Vista Pumping Station, which effects a distinct gain in economy and convenience.

The 7,000,000-gallon pumping engine built by the Snow Steam Pump Co. of Buffalo, New York, and erected by the Machinery & Electrical Co. of this city, was added to this station last June, and has been running successfully ever since.

GARVANZA SERVICE.

The people of Garvanza bought and presented to the Department a site for a small reservoir to supply some three or four hundred consumers occupying grounds too elevated to be served from the high service reservoir. A concrete-lined reservoir has been built thereon and a triplex power pump driven by a gasoline engine provided to supply it, so that the service in that outlying but highly picturesque district is now all that could be desired.

ENLARGEMENT AND EXTENSION OF PIPE SYSTEM.

As will be seen from the table of pipe laid during the year which follows, there was added to the system 37.63 miles of pipe ranging in size from 4 inches to 24 inches in diameter. This amount does not include the mileage added by the purchase of the West Side plant, nor is any account being taken of the many miles of temporary pipe of small size that was laid to supply the great number of outlying tracts recently subdivided and in which it was necessary to provide hasty means of supplying water to settlers thereon far in advance of the Department's financial ability to lay pipes of the proper size.

The aggregate weight of the cast-iron pipe laid during the year exceeded 3400 tons, in addition to which about 260 tons of steel pipe was laid, most of which was used in the extension from the main conduit before mentioned.

At the election held for the purpose of voting on the bond issue for the purchase of the West Side works, an issue of

the amount of money available to buy the needed to provide
the water system. We have the proposed bonds
and we have the money to pay them. These bonds have not
been issued yet. They are not due until 1950 but as the land
is being developed and there is no timber or seedlings, we were
forced to issue a portion of the bonds out of the
proceeds of the bonds to meet pressing needs, such
as the purchase of tractors.

WATER SUPPLY

In the early days, water supply was
obtained from wells and streams. It was
not until 1910 that we obtained water from
the Colorado River. This is the only water
available to us. We have no streams or
wells. We have no water storage tanks.
We have no water treatment facilities.
We have no water distribution system.

We have been recently challenged
by the Colorado River Compact
to obtain our water directly from
the Colorado River. We are from the
opinion that this is a good
idea and wellfounded.
We are in nature's dilemma.
Water law and ex-

cepting the challenge. In the future, it
will be a problem to us because there
will be a time when the city's
water needs will exceed what
we can obtain from the river. Otherwise, we
will be forced to depend on weather

and rainfall. "The water is limited" it was

only necessary to make temporary drafts on the surplus water that was usually used for irrigating purposes, but the whole flow of the stream is now devoted to domestic use, and the Zanja system abandoned. This caused a good deal of hardship to many who had rich alfalfa fields and orchards within the city limits, but they patiently accepted the inevitable and relinquished the rights they or their predecessors had held for over a century.

The mean flow of the Los Angeles river for the summer down to the last point of gravity diversion at the headgate of the old Water Company's conduit was 27,640,000 gallons in 24 hours. The minimum observed flow (that of September 7th) was 25,943,000 gallons. This is certainly a noble stream to be found running in a semi-arid country after a long succession of dry years, and speaks volumes for its constancy and reliability as a source of municipal supply.

There are but two other streams on this side of the mountains that can at all compare with it, but it would cost many millions to purchase either of them, as their waters have been used from time immemorial to water the rich agricultural sections created by such use.

The time has come, however, when we shall have to supplement its flow from some other source. This does not, of course, mean its abandonment, as some who are evidently not familiar with water conditions in Southern California have suggested, and who will doubtless find if they are city tax-payers that the mere duplication of it will cost quite enough without going to the extent of giving it all away in order to make a new start.

Let us review the conditions that prevailed during one of the periods above mentioned last summer, and which will amply show that earnest and immediate steps are necessary to procure additional water.

Taking the 10-day period beginning July 20th on the morning of which the reservoirs were all full.

During this period the average daily rate of flow into the

reservoirs was maintained as follows:

	Gallons
From the river	27,255,000
From the Jefferson street plant	1,098,000
From the Narrows gallery	4,199,000
From the Burbank gallery and pump.....	2,584,000
From the Los Feliz point pump.....	646,000
	<hr/>
	35,782,000

It was found that up to July 30th the reservoir had lost an average of 3,494,000 gallons per day, which shows that the consumption for the 10 days averaged 39,276,000 gallons daily, and that in the meantime the reservoirs had been half emptied. Fortunately at this time the temperature moderated and the warning of the Department began to have its effect to such extent that the consumption dropped to about 33,000,000 gallons daily, thus enabling us to fill the reservoirs again.

It was only due to such panicky draughts as the above that the city's supply was in any way endangered last summer, as the average consumption was not much in excess of 34,000,000 gallons daily and the minimum supply from all sources was never as low as that amount at any time. It is true that there was no water to spare to be put into the park lakes at that season of the year, and it might as well be made known that it is not probable there will ever be in the future, but to offset that condition processes have been successfully utilized all over the East by which impounded waters can be kept fresh enough even for domestic use indefinitely, and if those means are intelligently resorted to here the lakes need not be sacrificed.

FUTURE SUPPLY.

With anywhere like a normal rainfall the coming winter and the intervention of the Court to prevent an extension of pumping in the San Fernando Valley, we shall undoubtedly be amply able to supply the city next year when the developments now under way are completed.

These developments consist of the two groups of wells, one at the South city boundary near Compton avenue, from which a yield of 4,000,000 gallons daily is expected, and the other is the one in the river bed just below where the last of the surface flow of the river is diverted, and from which it is expected a supply of about 5,000,000 gallons daily may be extracted without affecting the flow from the Narrows Gallery, situated about four miles farther down the valley, the theory being that this long stretch of sandy river bed will not be depleted before the excess waters of the fall and winter following comes to restore it.

The wells heretofore bored above this point and from which water was pumped at various times last summer, proved an absolute failure as far as increasing the supply was concerned, as it was found by accurate measurements that they decreased the flow of the surface stream by exactly the amount pumped, and that the river flow was at once restored when the pumping ceased.

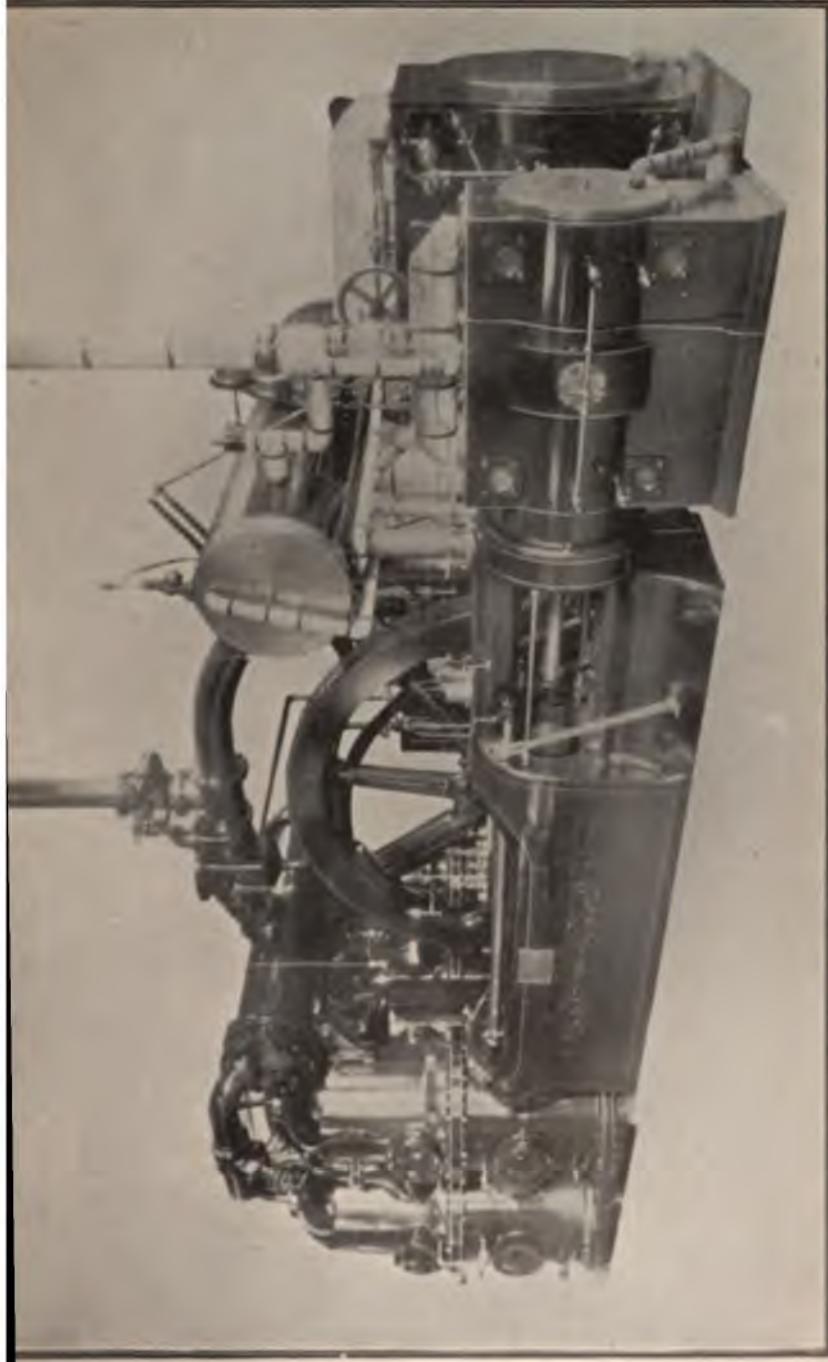
Work was resumed last month on the Narrows Gallery with a view to its extension the full distance of 2,000 feet originally contemplated. The water derived from this source is of exceptional purity and its addition to the city's supply proved of great value to us last summer. It is expected that the yield from it, which amounts to 4,250,000 gallons daily, will be much increased by the extension, and as there can be no doubt as to its permanence, its cost will prove a good investment.

While it is true that all the efforts made by the Department to increase the supply, with the exception of the one above noted, have proved successful, it must be admitted that we will have about reached the limit when the Compton avenue wells and the group below the old conduit diversion of the river are exploited.

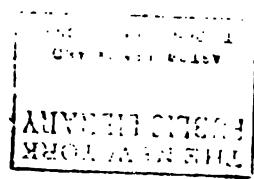
This being the case, we must turn our attention to remote supplies, for, as all are aware, the whole surrounding country is in about the same dilemma as this city in regard to water, and the grave problem confronts us that was mentioned in

The following suggests
what will probably
occur in the event of the
present drought continuing.
The first effect will
be to dry up streams of the
upper and middle miles of
the rivers, thus as the drouth
continues to dry up, com-
pelling the farmers to resort to
irrigation to keep their orchards

has been fully studied by engineers, and the results made available by W. C. Mendenhall, who presented them to him before the meeting. The inclusions arrived at the same time as the record with those of the first occurrence covering a period of about four months of water from the same source, and were exhausted at a rate corresponding by maximum



CHROSS COMPOUND SNOW PUMP, 7,000,000 GALLONS CAPACITY



It must not be lost sight of that in a country of such scant rainfall as this it takes the product of a large drainage basin to provide water for either an area of high cultivation or dense urban population, it being doubtful if the ratio of water shed to irrigated area exceeds twenty to one in any of our southern drainage basins. Compare, for instance, the nearly 300 million gallon daily production of the 320 square miles of drainage area that supplies New York City (not including Brooklyn) with that of the 35 to 40 million gallons daily yield from the nearly 500 square miles of the water shed supply Los Angeles, and the difficulties of our situation will be appreciated; in fact, it may be stated that as this city takes her rank among the large cities of the United States (and many believe that it is her destiny to do so), the per capita cost of her water works will necessarily exceed that of any of her sisters, due to her geographical position in a semi-arid country environed by a desert. In curious contrast to this is the fact that her present works have in all probability cost her citizens less in proportion to population than any city in the United States.

While the per capita consumption of this city has been reduced about 35 per cent in the past two years, it is still much too high, being at present about 190 gallons during the hot months. Careful scrutiny of the meter records affords enough data on which to base the hope that it may be reduced to 125 gallons. Should this hope be realized, our last summer's supply would be sufficient for a population of 275,000.

METERS.

Reference to the tables will show that the number of meters has been doubled during the year, there being now in use 3485, as against 1726 at the date of last year's report.

As an example of the practical effect of the operation of the meter system in the business section of the city, which is now nearly all metered, we will take the case of the three blocks bounded as follows, respectively: First, Main, Second and Spring streets; Second, Main, Third and Spring streets; and

Third, Spring, Fourth and Broadway.

The aggregate assessed flat rate on these three blocks \$897.75, while the meter rate for the month of October \$864, or a difference of $3\frac{3}{4}$ per cent in favor of the consu

When the meters were first put on, not alone on those bl but on all the blocks so far metered, the consumption aver more than double what it does now, and it is quite certain in the twenty-one blocks metered in the business section, a ing of not less than 2 million gallons a day has been effe by their use.

Taking another class of property, the following table sh the meter and assessed flat rate for one year on a block of class residences in the southwest part of the city, all of w have extensive lawns and shrubbery and some of them ha over a hundred feet of frontage, besides extensive stables out-buildings:

Meter Rate Per Annum.	Flat Rate Per Annum	Increase Under Meter.	Decrease Under M-
72.85	34.80	109%	
62.15	33.00	88%	
50.00	30.00	55%	
81.15	20.40	207%	
40.15	30.00	28%	
31.85	24.00	32%	
22.40	33.00		33%
20.00	27.00		6%
38.25	24.00	37%	
32.25	27.00	10%	
30.05	24.00	52%	
26.50	27.00	7%	
41.00	34.80	19%	
20.85	28.20	6%	
17.045	54.0	232%	
42.25	34.20	23%	
22.05	30.00		26%
10.140	33.00	100%	
31.45	30.00		13%
50.00	27.00	107%	
68.00	43.20	39%	
66.05	30.00	91%	

The wide variation in consumption here shown proves the folly and inequality of the flat rates which purported to represent the value of the water required for each of those premises, but naturally took no note of the personal equation of the gardener's notion of what was requisite. A little computation disclosed the fact that of the two highest consumers in the list, one used an amount of water during the year sufficient to cover his whole property to a depth of 8 feet $6\frac{1}{4}$ inches, while the other used a depth of 8 feet even.

Of the two lowest, one used enough to cover his lot to a depth of 3 feet $4\frac{5}{8}$ inches and the other 2 feet $2\frac{7}{8}$ inches.

If there is any difference in the appearance of the verdure on any of these premises, it is not visible to the naked eye, and it is a safe assumption that without the restraint of the meters the amount consumed on all of them would approximate very closely the larger amount above given.

As to the cost of the meters, which was at first urged as a serious objection to their use, it has been found that up to date they have not cost the city a dollar, for it quite frequently happens that the first month's bill on a place whose owner is under the impression that a few leaky fixtures or a closet out of repair does not amount to anything, pays the whole cost of the meter in excess of the former assessed rate. Your Honorable Body doubtless still remembers the ingenuous plea for a rebate of the consumer whose bill jumped from four dollars to forty-four on the ground that he did not know that there had been a meter put on his place.

STATEMENT OF PIPE LAID DURING THE YEAR ENDING NOVEMBER 15, 1904.

Location	S.	T.	Y.
Flower street, Fourth to Sixth	1	1	8
Fifty-first street, Central to San Pedro	1	1	7
San Julian street, Fifth to Ninth	1	1	7
Twenty-second street, San Pedro to the harbor	1	1	7
Melvin street, between Main and Market	1	1	7
Twelfth street, Union to Second	1	1	7
Main street, Avenue to Market	1	1	7

LOCATION.	Size inches	Length feet
Moulton street, between Alhambra and S. of Main street....	4	1110-
Gladys avenue, Fifth to Seventh street.....	4	1641
Banning street, at Vignes street.....	4	15
Fifth street, between Olive and Grand avenue.....	4	795-
Grand avenue at Fifth street.....	4	15
Hope street at Fifth street.....	4	49
Avenue 43 at Pasadena avenue and west.....	4	447
Avenue 44 at Pasadena and west	4	447
Fifty-second street at South Park avenue.....	4	24
Fifty-second street, between San Pedro and Walrath streets.	4	1,332-
South Park avenue, Fifty-first to Fifty-fourth streets.....	4	997
Fifty-third street at South Park avenue.....	4	24
Fifty-fourth street, between San Pedro and Main street.....	4	1158-
Fifty-third street, between Main and Walrath streets.....	4	1,483-
Main street, Gibbon to Lamar street	4	361
Fiftieth and Central avenue to South Park.....	4	2667
Forty-ninth street, Dominguez to South Park avenue.....	4	1908-
Ortega street at McKinley avenue.....	4	53
McKinley avenue, Ortega to Forty-ninth street	4	257
Forty-eighth street and McKinley to South Park avenue....	4	1,344
Vernon avenue, Staunton to Honduras street.....	4	554
Staunton street at Vernon avenue and south.....	4	468-
South Park avenue, Forty-eighth to Fifty-first streets.....	4	11,31
Main street, north and south of Fifty-fourth street.....	4	451
Fifty-fourth street at Main street.....	4	56-
Boyle avenue, Stephenson to St. Louis street.....	4	350
St. Louis street, Boyle avenue to Hollenbeck avenue.....	4	471
Central avenue, Fifty-seventh to Fifty-eighth street.....	4	193
Grand avenue at Fourth street	4	26-
Seventeenth street at San Pedro street and east.....	4	852-
Merchant street at Seventh street.....	4	28
Ceres avenue at Seventh street	4	28
Third street at Figueroa street.....	4	25
Carondelet street at Eighth and north	4	6,36
Staunton street at Fourth street and south.....	4	451
Seventeenth street at Staunton street and east.....	4	654
Staunton street at Forty-seventh and north.....	4	566-
Ann street at Main street	4	80
Leroy street at Main street	4	24
Sotello street at Main street.....	4	56-
Bloom street at Main street	4	24
Elmyra street at Main street	4	80-

LOCATION.	Size inches	Length feet
Main street, Wilhardt street to Mesnager street	4	559
South avenue south of Forty-seventh street.....	4	521
Staunton street, between Forty-seventh and Rubio streets..	4	1140
Figueroa street at Second street.....	4	19
Beaudry avenue at Second street	4	0
Coronado street, Seventh to Ninth street.....	4	1,300
Maple avenue at Ninth street.....	4	56
Vernon avenue at South Park avenue and east.....	4	656
Eastlake avenue at Henry street and north	4	250
Eastlake avenue, Altura street to George street.....	4	407
Thirty-fourth street at Central avenue and east.....	4	732
Winfield street, Sentous street to Valencia street.....	4	1150
Sentous street at Winfield and north	4	195
Alvarado street, between Sunset Boulevard and Scott street..	4	1566
Berkeley street, Allesandro street to Alvarado street.....	4	395
Alvarado street at Berkeley street and south.....	4	518
Winfield street at Valencia street and west	4	586
Grand avenue, between Fifth and Sixth streets.....	4	660
Winfield street, between Burlington and Union avenue.....	4	1610
Echo Park Road, Viola street and north.....	4	1,360
Ann street, Main street to Maud street.....	4	318
Temple street at New High street.....	4	4
Hobart Boulevard, between Twenty-eighth and Thirtieth sts.	4	1147
Belvidere street, Sunset Boulevard to Lucile street.....	4	510
Central avenue at Second and Third streets.....	4	18
Normandie avenue, north and south of Thirtieth street....	4	669
Grandview avenue at Ninth and north	4	610
Brighton avenue, Jefferson and north	4	521
Forty-third street, west of Moneta avenue	4	1212
Normandie avenue south of Forty-sixth street	4	625
Brighton avenue, Forty-sixth and south	4	620
Halldale avenue, Forty-sixth and south.....	4	620
Diamond street, east and west of Fremont avenue	4	706
Twenty-fourth street, at Grand avenue	4	46
Twenty-seventh street, at Grand avenue	4	56
Central avenue, Fifth to Wilde street	4	267
Fifth street at Central avenue	4	17
Sixth street at Central avenue	4	9
Central avenue north of Fourth street	4	713
Gates street at Main street	4	53
Main street at Gates street	4	129
Alhambra avenue, between Gates and Thomas streets	4	79

STREET	Size inches	Length feet
Twenty-fourth street, Grand avenue	4	23
Twenty-third street, Grand avenue	4	23
Twenty-second street, Grand avenue	4	79
Twenty-first street, Grand avenue	4	59
Twenty-second street, Grand avenue	4	23
Twenty-first street, Washington street and north	4	1210
Twenty-second street, Washington street and south	4	310
Twenty-third street, Franklin Avenue and south	4	1373
Twenty-fourth street, Franklin Avenue and east	4	305
Twenty-fifth street, Franklin Avenue to Main street	4	1186
Twenty-sixth street, Franklin Avenue to Main street	4	1164
Twenty-seventh street, Thirty-seventh street	4	3
Twenty-eighth street, Western Avenue to Hermosa street	4	1266
Twenty-ninth street, Webster and south	4	744
Twenty-ninth street, Whittier street	4	22
Thirty-first street, Eighth and south	4	394
Thirty-second street, south of Vernon Avenue	4	1847
Thirty-third street, Monroe Avenue	4	24
Thirty-fourth street, Monroe street to Maple Avenue	4	1060
Thirty-fifth street, Thirty-seventh street and north	4	162
Thirty-sixth street, Forty, north and south	4	223
Thirty-seventh street, Central Avenue to McKinley Avenue	4	1376
Thirty-eighth street, between Loma and Honduras streets	4	866
Thirty-ninth street, between Alvarado and Grand Avenue	4	550
Forty-first street, between Loma and east	4	931
Forty-second street, Hope street and east	4	442
Forty-third street, Loma street to Main street	4	2265
Forty-fourth street, Loma street and east	4	1275
Forty-fifth street, between Alvarado and Whittier Boulevard	4	656
Forty-sixth street, between Vernon Avenue, east and west	4	899
Forty-seventh street, Vernon Avenue, east and west	4	903
Forty-eighth street, between Pedro and Central Avenue	4	2300
Forty-ninth street, between Pedro and Central Avenue	4	15
Forty-first street, between Pedro and Central Avenue	4	2263
Forty-second street, between Pedro and Central Ave	4	2143
Forty-third street, between Pedro and Central Ave	4	2122
Forty-fourth street, between Pedro and Central Avenue	4	3742
Forty-fifth street, between Pedro and Central Avenue	4	219
Wadsworth Avenue, between Loma and Hope street	4	1357
Twenty-third street, between Whittier and Loma, to Main street	4	2224
Whitmore Avenue, between Loma and Hope street	4	540
Twenty-fourth street, between Loma and Hope street	4	23

LOCATION.	Size inches	Length feet
Rich street, at Pico street.....	4	23
Delong street, at Pico street.....	4	23
Georgia street, at Pico street.....	4	23
Forty-first street, Vermont avenue to Normandie avenue....	4	2823
Valencia street, at Eighth and north.....	4	306
Eighth street, Union avenue to Valencia street.....	4	620
Redondo street at Elmyra street and south.....	6	138
Lyons street, between Vignes and Macy streets.....	6	1555
Vignes street, Commercial to First street.....	6	1919
Hope street, north of Fifth street.....	6	300
Mozart street, Duillard street to Avenue 18.....	6	439
Aurora street at Baker street.....	6	30
Twelfth street, Central avenue to Paloma street.....	6	844
Mozart street, Avenue 18 to Avenue 19.....	6	241
Alameda street at First street.....	6	10
Duillard street at Main street.....	6	59
Main street, Duillard street to Clover street.....	6	96
Duillard street, Mozart street to Main street.....	6	304
Darwin street at Duillard street and east.....	6	27
Main street, Duillard street to Moulton street.....	6	1019
Grand avenue, First street to Fourth street.....	6	1888
First street, Hill street to Broadway.....	6	410
Eighth street, Central avenue to Gladys avenue.....	6	1504
Jackson street, Wilmington street to Alameda street.....	6	682
Eighth street, Towne avenue to San Pedro street.....	6	993
Fourth street, Wall street to San Pedro street.....	6	551
Wall street, between Fourth and Boyd street.....	6	628
Fourth street at Hill street and east	6	52
Hill street at Pico street and north.....	6	511
Wall street, Pico street to Seventh street.....	6	2031
Chavez Ravine Road, Reservoir street and north.....	6	2171
Compton avenue, Twentieth to Adams street.....	6	2375
Hoover street at Pico street and Quincy street.....	6	33
Twenty-second street at Grand avenue.....	6	79
Sixth street at Central avenue.....	6	26
Thirtieth street at Grand avenue	6	56
Pico street, Main to Figueroa street.....	6	2842
Marengo avenue at State street.....	6	22
City View street, Breed street to Soto street.....	6	1251
Moneta avenue, Thirty-ninth street to Forty-third street.....	6	3063
Wall street, Seventh street to Twelfth street.....	6	3680
Eighth street at Wall street.....	6	19

LOCATION.	Size inches	Length feet
Witmer street at Seventh and north.....	6	618
Thirty-sixth street, Maple avenue to east of Adair street.....	6	1374
Twenty-second street, Main to Figueroa street.....	6	2463
Macy street at Keller street.....	6	36
Sixth street between Kohler street and San Pedro streets.....	6	2972
Thirtieth street between Main and Olive streets.....	6	1184
Eighth street, Main street to Maple avenue.....	6	1966
Bond street at Pico street.....	6	23
Thirty-eighth street, Central avenue to South Park avenue	6	2663
Third street, Central avenue to Omar avenue.....	6	514
Eleventh street, King street to Harvard Boulevard.....	6	639
Twenty-ninth street, Central to San Pedro street.....	6	2300
Avenue 18, Downey avenue to Mozart street.....	8	1381
Main street, Bloom street to Ann street.....	8	1274
Eleventh street, Magnolia avenue to Jasmine street.....	8	5403
Central avenue at Second street and south.....	8	587
Eighth street at Central avenue.....	8	77
Fifth street at Central avenue.....	8	24
Main street at Jefferson street.....	8	24
Third street at Central avenue.....	8	14
Railroad street, Main street to Redondo street.....	10	618
Main street, Redondo street to Railroad street.....	10	651
Redondo street, San Fernando street to Railroad street.....	10	235
First street at Alameda street.....	10	12
Highland Reservoir to Avenue 63.....	10	126
Avenue 63 at Elgin street and south.....	10	182
Elgin street at Avenue 63 and east.....	10	25
Through Parkdale tract to High Service Reservoir.....	10	494
First street at Alameda street.....	12	41
Seventh street, Central avenue to Alameda street.....	12	1019
Central avenue, between Thirty-second and Jefferson streets.....	12	1170
High Service Reservoir, Garvanza	12	150
Wilshire Boulevard, Hoover street to Vermont avenue.....	12	1666
Central avenue, Ninth street to Washington street.....	12	3369
Wilshire Boulevard at Juanita and east.....	12	578
Grand avenue, Washington street to Jefferson street.....	12	5129
Jefferson street, Grand avenue to Main street.....	12	2460
Figueroa street, Beaudry avenue to Everett street.....	16	520
Everett street at Everett Place and north.....	18	477
North of "Angelino" High Service Reservoir	18	110
Buena Vista street at College street.....	18	13
Figueroa street, Third street and north	20	661

LOCATION.	Size inches	Length feet
Second street, Figueroa street to First street.....	20	2840
Lakeshore avenue, First street to Bellevue avenue.....	20	3237
Buena Vista street at College street.....	22	12
From the south end of the Main Conduit to the corner of Bellevue and Lakeshore avenues.....	24	12,813

SUMMARY OF PIPE LAID DURING THE YEAR ENDING NOVEMBER 18, 1904.

Size inches.	Length feet.
4	102,626
6	48,680
8	8,784
10	2,343
12	15,582
16	520
18	600
20	6,738
22	12
24	12,813
 Total	 198,608—37.63 miles

PIPE ACQUIRED FROM THE "WEST SIDE" WATER WORKS BY PURCHASE.

Size inches.	Length feet
4	78,720
6	28,850
8	22,020
10	2,135
12	8,340
 Total	 140,711—26.63 miles

FIRE HYDRANTS.

In System November 15th, 1903.....	722
Single Fire Hydrants placed during year.....	68
Double Fire Hydrants placed during year.....	29
Acquired from West Side Water Works.....	42
Total in System November 15th, 1904.....	861

SERVICES

In System November 15th, 1903.....	30,078
Acquired from West Side Water Works.....	4,335
Added during the year ending November 15th, 1904.....	5,145
Total Services	39,558

SERVICE BY WARDS, PUT IN DURING YEAR ENDING NOVEMBER 15, 1904.

Size.	1	2	3	4	5	6	7	8	9	Total
3/4-in.	449	347	57	190	488	1396	135	25	527	3614
5/8-in.	122	92	66	187	204	448	64	4	114	1301
1 -in.	12	16	11	44	14	25	23	3	8	156
1 1/2-in.	3	2	2	2	0	2	4	1	0	16
2 -in.	0	2	7	0	1	3	2	4	2	21
6 -in.	0	0	0	0	0	0	0	1	0	1
	586	459	143	423	707	1874	228	38	651	5109
Not located										36
Total										5145

GATES.

Put in during the year ending November 15th, 1904:

4-inch	232
6-inch	88
8-inch	30
10-inch	3
12-inch	19
16-inch	2
18-inch	1
20-inch	3
Total	378

Included in the above list are the following Gates acquired from the West Side Water Works:

4-inch	92
6-inch	20
8-inch	18
10-inch	2
12 inch	5
Total	137

METERS.

SET DURING YEAR ENDING NOVEMBER 15th, 1904.

OWNED BY CITY.

Size Inches	November 15th		Increase	Decrease
	1903.	1904.		
1/2 inch	814	1084	270	—
5/8 inch	453	920	467	—
1 inch	205	381	176	—
1 1/2 inch	20	70	50	—
2 inch	87	99	12	—
3 inch	14	23	9	—
4 inch	6	10	4	—
6 inch	2	0	—	2
City	1001	3193	2192	Net Inc. 1592

PRIVATE.

Size Inches	November 15th		Increase	Decrease
	1903.	1904.		
1/2 inch	82	100	18	—
5/8 inch	10	58	48	—
1 inch	20	37	17	—
1 1/2 inch	2	3	1	—
2 inch	1	1	0	—
4 inch	1	1	0	—
Private	125	262	137	—

Meters placed during the year

Total Meters in use

There were 101 meters acquired from the West Side Water Works.

The following Pipe and Services, lying west of the City, outside the present City limits, have been transferred to the West Los Angeles Water Company:

2-inch pipe	.....	37,780 feet.
3-inch pipe	.....	14,540 feet.
Services	.....	102

The efficiency and morale of the employes of the Department have been maintained at the usual high standard throughout the year and I take this opportunity of expressing my appreciation of their strict attention to their various duties during the most arduous year in the history of the works.

I also thank your Honorable Body for the kindly consideration you were pleased to accord the many recommendations suggested for the operation and betterment of the plant and which had the effect of turning to a pleasure what otherwise would have been a most trying burden.

WM. MULHOLLAND, Supt.

Report of Department Auditor

Los Angeles, Cal., Dec. 1, 1904.

To the Honorable Board of Water Commissioners
Of the City of Los Angeles:

Gentlemen:—I herewith beg to submit the annual report of the financial operations of the Water Department for the year ending November 30th, 1904:

RECEIPTS

Balance by Last Report	\$ 22,026.06
Water	\$84,578.00
Water, West Side (Pending Purchase)	5,106.07
Permits	12,540.84
Services	53,112.70
Material and Labor	8,653.20
Rent	2,153.00
Meters	2,000.00
Deposits	171.00
Deposits, West Side	384.00
Zantias	3,573.00
Uncalled for Demands	51.50
L. V. City from Interest Acct.....	495.32
	—
	772,078.32
	\$705,004.38

DISBURSEMENTS

Improvements and Additions to Plant.

Construction (Pipe, etc.).	\$322,245.00
Main Supply Conduit.....	76,730.54
Head Works	12,080.25
Reservoirs	40,001.61
Infiltration Gallery	1,845.27
Land and Buildings.....	30,923.49
Meters	10,802.40
	\$508,141.40
Maintenance	7,202.00
Operating	101,400.77
Utilities	39,117.10
Interest Fund on Bonds.....	8,163.00
Sinking Fund on Bonds.....	67,000.00
Deposits Returned	452.35
	\$777,813.74
Balance December 1st, 1904	\$18,866.00

Balance December 1st, 1903 \$ 18,000

RECEIPTS BY MONTHS.

December, 1903.

Water	\$ 50,638.41
Permits	888.80
Services	3,185.00
Sundries	523.19
Rent	8.00
Meters	75.00
Deposits	20.00
Zanja Department	524.00
Total	\$ 55,862.40

January, 1904.

Water	\$ 51,472.78
Permits	1,297.18
Services	3,139.00
Sundries	2,016.81
Rent	128.00
Meters	123.00
Deposits	10.00
Uncalled for Demands....	7.00
Zanja Department	605.25
Total	\$ 58,859.02

February, 1904.

Water	\$ 51,194.95
Permits	1,194.93
Services	3,153.70
Sundries	1,087.34
Rent	173.00
Meters	91.00
Deposits	10.00
Zanja Department	478.00
Total	\$ 57,202.02

March, 1904.

Water	\$ 51,266.94
Permits	1,080.06
Services	3,042.00
Sundries	407.50
Rent	180.00
Meters	100.00
Deposits	30.00
Zanja Department	402.25
Total	\$ 57,232.35

April, 1904.

Water	\$ 52,611.92
Permits	847.85
Services	4,595.00
Sundries	547.25
Rent	150.00
Meters	233.00
Deposits	10.00
Cancelled Demand	43.00
Zanja Department	594.00
Total	\$ 59,041.02

May, 1904.

Water	\$ 52,706.79
Permits	586.20
Services	4,456.00
Sundries	256.25
Rent	130.00
Meters	102.00
Deposits	20.00
Zanja Department	895.50
Total	\$ 59,161.74

June, 1904.

Water	\$ 59,648.25
Permits	924.34
Services	5,516.00
Sundries	227.05
Rent	158.00
Meters	226.00
Total	\$ 66,609.64

July, 1904.

Water	\$ 60,714.43
Permits	581.17
Services	5,070.00
Sundries	441.29
Rent	188.00
Meters	247.00
Deposits	384.00
Total	\$ 67,625.80

August, 1904.

Water	\$ 64,653.07
Permits	1,271.10
Services	4,892.00
Sundries	1,383.71
Rent	128.00
Meters	226.60
Deposits	41.00
Transfer by City Bal. in L.	
& S. Fund, 1895	495.32
Total	<u>\$ 73,000.80</u>

September, 1904.

Water	\$ 63,257.23
Permits	1,037.80
Services	5,192.00
Sundries	490.30
Rent	245.00
Meters	137.00
Deposits	10.00
Total	<u>\$ 70,345.33</u>

October, 1904.

Water	\$ 63,587.55
Permits	1,405.36
Services	4,524.00
Sundries	722.95
Rent	158.00
Meters	143.00
Deposits	20.00
Total	<u>\$ 70,500.86</u>

November, 1904.

Water	\$ 63,892.85
Permits	1,515.75
Services	5,748.00
Sundries	513.65
Rent	533.00
Meters	276.00
Uncalled for Demand	1.50
Bal' West Side Collection	4,125.90
Total	<u>\$ 76,606.65</u>

Grand Total \$772,078.32

DISBURSEMENTS BY MONTHS.

December, 1903.

	LABOR	MATERIAL	TOTAL
General Construction	\$ 6,742.55	\$12,291.22	\$19,033.77
Conduit	8,022.25	1,175.41	10,097.66
Head Works	2,050.55	985.75	3,042.30
Reservoirs	48.00		48.00
Maintenance	31,105	271.43	31,376.43
Operating	4,936.25	3,548.03	8,584.28
Land and Building		3,377.42	3,377.42
Meters		2,007.00	2,007.00
Zansas	640.00	35	640.35
Deposits Returned			1.00
	<u>\$24,578.05</u>	<u>\$21,617.57</u>	<u>\$46,195.62</u>

January, 1904.

	LABOR.	MATERIAL.	TOTAL.
General Construction	\$ 5,881.55	\$ 5,927.38	\$11,808.93
Conduit	8,607.90	18,268.66	26,876.56
Head Works	2,041.85	834.63	2,876.48
Reservoirs	277.75	308.00	585.75
Maintenance	298.50	482.35	780.85
Operating	5,096.25	2,275.61	7,371.86
Land and Buildings		1,226.15	1,226.15
Meters		683.75	683.75
Zanjas	466.00	.88	466.88
	<hr/>	<hr/>	<hr/>
	\$22,669.80	\$30,007.41	\$52,677.21

February, 1904.

General Construction	\$ 8,734.95	\$ 2,662.07	\$11,397.02
Conduit	12,210.08	10,233.83	22,443.91
Head Works	1,946.90	379.47	2,326.37
Reservoirs	2,858.20	1,740.99	4,599.19
Maintenance	297.00	205.10	502.10
Operating	5,350.53	2,568.94	7,919.47
Land and Buildings		496.02	496.02
Meters		189.00	189.00
Zanjas	506.00		506.00
	<hr/>	<hr/>	<hr/>
	\$31,909.66	\$18,475.42	\$50,385.08

March, 1904.

General Construction	\$ 9,053.05	\$16,175.79	\$25,228.84
Conduit	5,857.50	9,837.40	15,694.90
Head Works	608.25	323.91	1,022.16
Reservoirs	5,127.02	1,342.13	6,469.15
Land and Buildings		1,713.77	1,713.77
Maintenance	297.85	204.36	502.21
Operating	5,137.70	770.42	5,908.12
Land and Buildings		1,306.62	1,306.62
Meters		800.72	800.72
Zanjas	502.00	2.02	504.02
Deposits Refunded			30.00
	<hr/>	<hr/>	<hr/>
	\$29,733.37	\$31,326.04	\$58,059.41

April, 1904.

	LABOR.	MATERIAL.	TOTAL.
General Construction	\$ 9,073.80	\$36,020.42	\$45,093.22
Conduit	1,400.80	89.06	1,580.76
Head Works	591.97	57.47	649.44
Reservoirs	4,701.51	4,786.88	9,488.39
Tunnel		33.36	33.36
Maintenance	322.00	240.07	571.97
Operating	5,254.15	1,417.04	6,671.19
Land and Buildings		286.00	286.00
Meters		297.65	297.65
Zansas	706.50	89.57	796.07
Deposits Returned			119.35
	<hr/>	<hr/>	<hr/>
	\$23,041.63	\$43,336.42	\$66,397.40

May, 1904.

General Construction	\$ 7,417.70	\$ 9,005.20	\$17,322.90
Conduit		33.75	33.75
Head Works	476.60	.25	476.85
Reservoirs	5,780.62		5,780.62
Maintenance	359.75		359.75
Operating	5,280.00	1,389.40	6,669.30
Zansas	684.00		684.00
Deposits Returned			20.00
	<hr/>	<hr/>	<hr/>
	\$10,979.57	\$11,308.60	\$22,288.17

June, 1904.

General Construction	\$ 6,821.80	\$12,781.08	\$19,602.88
Conduit		0.00	0.00
Head Works	308.00	220.65	528.65
Reservoirs	4,431.15	1,825.02	6,256.17
Maintenance	359.05	292.29	651.34
Operating	6,172.05	2,287.31	8,459.36
Meters		2,438.20	2,438.20
Land and Buildings		210.16	210.16
Zansas	223.25	0.08	223.33
Deposits Returned			30.00
	<hr/>	<hr/>	<hr/>
	\$18,315.30	\$20,082.79	\$38,428.09

July, 1904.

	LABOR.	MATERIAL	TOTAL
General Construction	\$ 7,786.95	\$14,376.32	\$22,163.27
Head Works	333.25		333.25
Reservoirs	2,342.95	1,278.47	3,621.42
Maintenance	400.60		400.60
Operating	7,028.15	418.72	7,446.87
Land and Buildings		16.90	16.90
Deposits Returned			10.00
	<hr/>	<hr/>	<hr/>
	\$17,891.90	\$16,090.41	\$33,992.31

August, 1904.

General Construction	\$ 7,522.28	\$38,484.77	\$46,007.05
Reservoirs	685.05	2,902.09	3,587.14
Maintenance	330.35	777.36	1,107.71
Operating	7,163.00	5,135.48	12,298.78
Land and Buildings		143.75	143.75
Meters		1,974.33	1,974.33
Zanjas		16.55	16.55
Transfer to Int. and Sinking Fund..			156,640.00
Deposits Returned			107.50
	<hr/>	<hr/>	<hr/>
	\$15,700.98	\$49,434.33	\$221,882.81

September, 1904.

General Construction	\$ 8,486.75	\$ 9,690.97	\$18,177.72
Head Works	529.35		529.35
Reservoirs		242.42	242.42
Maintenance	315.80	329.18	644.98
Operating	7,314.70	3,674.29	10,988.99
Land and Buildings		10,850.12	10,850.12
Meters		1,983.65	1,983.65
Deposits Returned			63.50
	<hr/>	<hr/>	<hr/>
	\$16,646.60	\$26,770.63	\$43,480.73

October, 1904.

General Construction	\$ 8,180.00	\$31,959.18	\$40,148.18
Reservoirs		21.36	21.36
Maintenance	341.55	337.85	679.40
Operating	7,000.30	3,125.30	10,125.60
Land and Buildings		12.40	12.40
Meters		5,849.60	5,849.60
Deposits Returned			50.00
	<hr/>	<hr/>	<hr/>
	\$15,530.85	\$41,305.69	\$56,886.54

November, 1904.

General Construction	\$ 8,221.65	\$37,130.38	\$45,352.03
Reservoirs	202.00		202.00
Head Works	1.40		1.40
Infiltration Gallery		98.14	98.14
Maintenance	333.30	143.37	476.67
Operating	7,133.80	1,929.25	9,063.05
Land		20,164.95	20,164.95
Meters		509.44	509.44
Deposits Returned			12.00
	<hr/>	<hr/>	<hr/>
	\$15,892.15	\$59,975.53	\$75,879.68

TOTAL RECEIPTS.

February 4th to November 30th, 1902.....	\$456,317.83
Year ending November 30th, 1903.....	614,264.92
Year ending November 30th, 1904.....	772,978.32

\$1,843,561.07

TOTAL DISBURSEMENTS.

February 4th to November 30th, 1902.....	\$314,163.56
Year ending November 30th, 1903.....	733,493.13
Year ending November 30th, 1904.....	777,813.74

1,825,470.43

Balance December 1, 1904 \$ 18,090.64

Thanking your Honorable Body for courtesies extended to all in this Department, I submit the above report.

L. M. ANDERSON, Auditor.



Fourth Annual Report of the Board of Water Com- missioners of the City of Los Angeles, California

Including

Report on Water Supply

W. M. MULHOLLAND
Superintendent

LIPPINCOTT & FARNER
Engineering Company



For the Year Ending November 30, 1905





Water Commissioners' Report

For the Year Ending November 30, 1905

including

REPORT ON WATER SUPPLY

by

WM. MULHOLLAND
Superintendent

and

LIPPINCOTT & PARKER
Consulting Engineers



LOS ANGELES, CALIFORNIA
1906

184350

Water Commissioners' Report

For the Year ending November 30, 1905

BOARD OF WATER COMMISSIONERS.

FRED L. BAKER.
GEN'L M. H. SHERMAN
JNO. J. FAY, JR.
WM. MEAD
J. M. ELLIOTT

OFFICERS.

JNO. J. FAY, JR., President.
JAS. P. VROMAN, Secretary.
WM. MULHOLLAND, Superintendent.
L. M. ANDERSON, Auditor.

— — — — —
Los Angeles, Cal., December 18, 1905.

To the Honorable Council of the City of Los Angeles:—

Gentlemen: In compliance with the requirements of the Charter, we beg to submit herewith the Fourth Annual Report of the Board of Water Commissioners, being for the fiscal year ending November 30, 1905.

It was the desire and purpose of the Board to include in this report a detailed and extended account of its work and proceedings in connection with the project of the city for obtaining a water supply in the Owens River Valley, but this has been prevented by the incomplete condition of many of the transactions.

A complete report covering this subject and embracing also the very elaborate report of Messrs. Lippincott and Mulholland on the hydrology of Southern California will be presented to the Council at a later date.

Respectfully,

BOARD OF WATER COMMISSIONERS.

By JNO. J. FAY, JR., President.

— — — — —

To the Honorable City Council of the City of Los Angeles:—

Gentlemen: We beg to submit to your honorable body the following report, pursuant to the statement made in our Annual Report, filed December 18, 1905, that a complete report with reference to the project of the city for obtaining a water supply in the Owens River Valley, and embracing the

report of Messrs. Lippincott and Mulholland on the hydrography of Southern California, would be presented to the City Council by this Board, at a later date.

The year of 1905 will, in all probability, be regarded in the future as one of the most important in the history of this city, by reason of the inauguration of one of the boldest undertakings for providing a municipal water supply ever attempted by a city of the size of Los Angeles. We, therefore, deem it proper to state, in brief detail, the necessity for entering upon the extraordinary project of bringing water from a source so distant as the Owens River, and to relate the steps that have been taken by this Board, both independently and in conjunction with your honorable body, for the purpose of securing for the city an adequate water supply.

It will be remembered that, in the three preceding annual reports of this board, it was impliedly, if not expressly, intimated that the city would soon outgrow her entire available water supply; and in the annual report of this board for the year ending November 30, 1904, the announcement was made in reference to the Los Angeles River, upon which we depend almost exclusively for water, that "the time has come, however, when we shall have to supplement its flow from some other source." In 1890 our population, as shown by the Federal census, was 50,395. By 1900 it had doubled. In the next five years it doubled again, and, by the first of January, 1907, it will probably reach 250,000.

The extraordinary growth of the city naturally provoked much public discussion of the limitations of our water supply, and the question of providing an additional supply engaged the most serious attention of this board.

Numerous projects were, from time to time, proposed by various parties, who had, or believed they had, water rights to sell to the city that would be adequate for her future needs, but the board decided that, before selecting any of them for the use of the city, a thorough investigation should be made of all available sources of water supply in Southern California. The board, accordingly, employed Mr. J. B. Lippincott, a well known hydraulic engineer, who, by reason of his extended investigations in this region for the United States Government, was exceptionally well fitted for this work, to make and submit a report on this subject, in collaboration with Mr. William Mulholland, the Superintendent of the Water Department, who, by reason of his long experience and practice as an hydraulic engineer in this part of the State, was well qualified to conduct such an investigation. The report of these gentlemen is presented herewith, and it will be found well worth perusal and study by every citizen having the city's interests at heart, as well as by those desiring to obtain a knowledge of the hydrography of Southern California.

This report conclusively showed that no adequate water supply could be obtained by the city in Southern California. Several months before it was formally presented to the board, the result of the extensive investigations of Messrs. Lippincott and Mulholland was made known to us, revealing the extreme seriousness of the situation in which the city was placed. It became evident to the board that the future growth and prosperity of the city depended upon the discovery of a source of water supply outside this section of the State; so that, when Mr. Frederick Eaton unfolded to the board his plan of obtaining water for the needs of the city from the Owens River

Valley, more than two hundred miles distant, it appeared to us to present the only feasible scheme for providing the city with a supply sufficient for its future needs. Subsequently, in the month of September, 1904, Mr. Mulholland, at our request, accompanied Mr. Eaton to the Owens River, following en route, approximately the course a conduit would have to take to bring water from that source to the city. Upon his return Mr. Mulholland reported to us that an abundance of pure water for the city's needs could be procured in the Owens River Valley, and that its conveyance to the city was entirely practicable. Whereupon, a corps of surveyors was put to work, under his direction, upon the most difficult portion of the route that would be traversed by the conduit.

Prior to this time agents of the United States Government, connected with its Reclamation Service, had been making investigation of the water supply in the Owens River Valley, with a view to the conservation of the great quantity of water annually flowing into the Owens Lake, and there lost, so far as any useful purpose is concerned, with the object of extending the irrigated area of the valley, and the data thus collected, coupled with the personal observations of Mr. Eaton, and others of long acquaintance with the hydrography of the Owens River drainage basin, was of great use to this board, in determining the sufficiency and availability of the Owens River as a source of water supply.

In April, 1905, Messrs. Fay and Elliott, of this board, accompanied by Mayor McAleer, City Attorney Mathews, and Messrs. Eaton and Mulholland, made a visit to the Owens River Valley, for the purpose of further investigating the water conditions existing there, and of considering a proposal from Mr. Eaton to sell and transfer to the city certain options and contracts for the purchase of lands and water rights along the Owens River.

After carefully considering all available information concerning sources of water supply, sufficient for the needs of the city, both in and outside of Southern California, the board became thoroughly convinced that the Owens River afforded the only adequate supply that could be obtained by the city at a cost which it would be justified in incurring. Having reached this conclusion, the board entered into a contract with Mr. Eaton for the acquisition of the property embraced in the proposal submitted by him, and devoted the available funds of the water department to this purpose. This property includes most of the riparian lands for a distance of about 40 miles along the river above Owens Lake, in Inyo county, and a reservoir site in what is known as Long Valley, in Mono county. These lands, besides being desirable and valuable on account of the appurtenant water rights, are advantageously located with reference to the acquisition of any additional property in that locality that the city may wish to purchase.

The proceedings of the board in these transactions were conducted with the utmost secrecy, in order to prevent speculators from anticipating the city in securing the property desired. The board was confident that its action, although taken without previous consultation with the Council, would receive its approval when the facts should be made known, and we are pleased to be able to state that our expectation in this regard was fully realized. The contracts above referred to made it necessary to provide for about \$700,000 in order to consummate the purchase of this property and to return to the Water Revenue Fund the amounts advanced by the board. Upon the recom-

members of this board, the Council, after due consideration of the subject, promptly called a special election and submitted to the people the proposition of voting \$ million and a half dollars for the purpose of compensating these purchases, making such additional ones as might be found expedient, and commencing the work of construction. We think it probable that no proposition ever submitted to the voters of any community was more unanimously received or more generally supported than this. Out of a total vote of 11,542, 10,787 were for and 755 against the issue of the bonds. The result of the election is the more remarkable when it is remembered that it virtually committed the city to an expenditure of more than \$20,000,000, the estimated cost of the "Owens River Project." But, while the voters of the city indicated in this unmistakable manner, their approval of the proposed plan for obtaining an additional water supply, and their readiness to proceed with its execution, it has been deemed wise, before asking the people to authorize the issue of other bonds for this purpose, to have the plans passed upon and approved by a board of competent engineers, of national reputation, and negotiations are now being conducted with a view of engaging experts for this service.

The Owens River is fed by numerous creeks and springs created by melting snow in the high Sierras, and, according to reliable reports, its average flow, during the year, probably exceeds 25,000 miner's inches, which is equivalent to a daily supply of 325,000,000 gallons. The attractiveness of the Owens River basin as a source of water supply is greatly enhanced when we consider that the Los Angeles River can hardly be depended upon to yield more than 2,500 inches of water, constant flow, for the use of the city.

While the chief value of this project is the abundant supply of wholesome water, sufficient for all the future needs of the city, yet we feel that mention should also be made, at this time, of the opportunities there will be for the development of electrical power along the line of the water conduit. The elevation above sea-level of the point on Owens River where the city will probably establish its first diversion works, is about 3,800 feet, or more than 2,500 above the elevation at the City Hall. It is estimated that, from the fall of the water at points along the conduit, at least 80,000 horse power might be developed, so that the city would have, from this source, after lighting its own streets, parks and buildings, a large excess of power available for domestic and other purposes. It is easy to perceive that the amount of revenue that might be derived from this source, together with the net income of the water department, would be sufficient to meet, if not the whole, at least a substantial part, of the indebtedness to be incurred by the city in completing this project.

It seems to us that the importance of the Owens River project to the City of Los Angeles cannot be overestimated. Not only are the present sources of water supply inadequate to meet the additional demands that will result from the rapid increase that can reasonably be expected in the population of the city, but observations made at various points in Southern California show that the existing sources of supply are becoming exhausted. The entire surface flow of all streams in the territory surrounding the city is appropriated to divers uses, and in addition, waters are being very extensively pumped from the available water-bearing gravel beds. At some places in Southern California the water plane in these gravel beds has, within the last few years,

fallen as much as one hundred feet. It is, therefore, apparent that, without an additional water supply, not only must the marvellous growth, of which the city is so justly proud, cease, but the comfort and safety of the present population would be seriously menaced.

The pueblo of Los Angeles was founded on the site of the present city, for the reason that the stream, now known as the Los Angeles River, afforded an ample water supply, both for domestic use and for irrigation. Much, if not all, of the growth from the original pueblo to the present city has been due to the availability of this water supply. The very existence of the city is dependent upon its water supply, and the limitation of its water supply must fix the limitation of its growth. We believe it is reasonable to expect that in proportion as the water supply obtainable from the Owens River Valley is greater than the present supply drawn from the Los Angeles River, so will the new Los Angeles which will follow the bringing of its water supply from the Owens River Valley be greater than the present city.

Before closing this report, we deem it proper to refer to the fact that to Mr. Frederick Eaton should be ascribed the credit of originating the idea that this city should go to the Owens River Valley for its water supply, and we acknowledge with pleasure our sense of the value and importance of his services in connection with the inauguration of the Owens River project.

Very respectfully,

JNO. J. FAY, JR.,

FRED L. BAKER,

J. M. ELLIOTT,

M. H. SHERMAN,

WM. MEAD.

Board of Water Commissioners of the City of Los Angeles.

**REPORT
OR
WATER SUPPLY**

**Wm. Mulholland
SUPERINTENDENT**

**Lippincott & Parker
CONSULTING ENGINEERS**

**LOS ANGELES, CALIFORNIA
1906**



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INTRODUCTION

To the Honorable Board of Water Commissioners of the City of Los Angeles:—

Gentlemen: Pursuant to your request made by resolution at your regular meeting of March 6, 1905, the undersigned proceeded to the task of collecting and tabulating the data which forms the bases of the report we herewith have the honor to submit.

Your instructions in their broadest interpretation were, to investigate:

- (1) The present source of Water Supply of the City of Los Angeles.
- (2) The limitations of such supply.
- (3) The present and future needs of the city, and incidentally that of the surrounding country.
- (4) Available sources from which an additional supply may be obtained south of the Tehachapi Mountains.
- (5) An estimate of cost of such additional supply.

A careful perusal and study of the reports of the Superintendent contained in the Annual Reports of your Honorable Board, reveals a condition of the city's water supply which should be regarded as threatening the future prosperity of the city were it found to be impracticable to supplement it with water from some other source than the one at present drawn upon.

The data contained in the annual reports, and especially in the one of 1902, go back far enough to give reliable information as to the yield of the Los Angeles River and the San Fernando Basin which supplies it, through a period that embraces within its range a cycle of wet years followed by a succession of extremely dry seasons, and into the present time, which may be regarded as a period approximating average conditions of precipitation, for by adding the rainfall of the last three winters and taking the mean we have an average of 15.93 inches, which is about the mean of the 27 years through which official observations have been made and record kept. It will scarcely be necessary to burden this report with matter pertaining to the nature of the city's title to the waters of the Los Angeles River from which our present supply is almost entirely derived. This right has been fully and irrevocably established by many Court decisions, and we may here assume that in so far as the needs of the inhabitants of the city are concerned their right is paramount to the extent of the total flow both surface and sub-surface of the entire drainage basin in which this stream has its origin.

Summarizing the present sources of water supply, both temporary and permanent, for the inhabitants of the City of Los Angeles, they are at this writing (July 1, 1905) as follows:

The surface flow of the Los Angeles River.....	46 Sec. Ft.
The sub-surface flow extracted from the tunnel under the Narrows above the Buena Vista Pump Station.....	9 " "
A temporary supply obtained from the Jefferson Street plant of the West Los Angeles Water Company, under a contract which expires in June, 1907.....	1.5 " "
The product of the wells at Slauson Avenue pumping plant.....	7 " "
The product of a pumping plant located in the river bed opposite Los Feliz Point.....	8 " "

Total	71.5 " "

Expressed in gallons this is equivalent to about 46 million daily. It must be borne in mind that the above quantity unfortunately cannot be regarded as being constant, as the flow of the Los Angeles River is affected by the greater or less abundance of rainfall in its drainage basin. In the estimate that follows, the minimum surface flow at Los Feliz Point is considered as the safest basis for comparison.

It will be seen by reference to the annual reports referred to that until the year 1903, much of the water of the Los Angeles River was used for irrigation, but that the gradual increase of population required the conversion of such use to that of the domestic needs of the city.

The rapidly diminishing flow of the stream due to greatly diminished rainfall, and quite appreciably to the pumping of considerable quantities for irrigation purposes by farmers whose lands lie closely adjacent to the stream, forced the Department to the necessity of supplementing the river flow by the addition of the plants above referred to.

The water thus obtained has so far sufficed to maintain a supply equal to the needs of the city, but the following extract from pages 23 and 24 of the Annual Report for 1904 will amply show the urgency for action in the procurement of an additional supply:

"Taking the 10-day period beginning July 20, on the morning of which the reservoirs were all full. During this period the average daily rate of flow into the reservoirs was maintained as follows:

	Gallons.
From the river	27,255,000
From the Jefferson Street plant.....	1,098,000
From the Narrows Gallery.....	4,199,000
From the Burbank Gallery and Pump.....	2,584,000
From the Los Feliz Point Pump.....	646,000

Total	35,782,000

"It was found that up to July 30 the reservoirs had lost an average of 3,494,000 gallons per day, which shows that the consumption for the 10 days averaged 39,276,000 gallons daily, and that in the meantime the reservoirs had been half emptied. Fortunately at this time the temperature moderated and the warning of the Department began to have its effect to such extent that the consumption dropped to about 33,000,000 gallons daily, thus enabling us to fill the reservoirs again."

The winter of 1904-5 yielded a rainfall of 19.35 inches, which is about 23 per cent above the normal. This increased precipitation has served not alone to check the decrease in the discharge of the stream which had been constantly diminishing for eleven years, but added to the flow of the Los Angeles River about three feet a second over what it was on the corresponding date in 1904.

In the meantime the city's population has increased not less than 12 or 15 per cent in the past year, but so effective has the use of meters proved that at no time during the present year has the daily consumption exceeded 37 million gallons per day, which leaves a reserve of about 9 million gallons should the yield of the above mentioned sources remain constant, but it must be borne in mind that as the season progresses there will be quite a considerable shrinkage in the flow of the river and possibly some decrease even in the yield from the other sources.

Quoting again from the report of 1904, we believe the following sentence to fully state the true condition of affairs:

"While it is true that all efforts made by the Department to increase the supply have proved successful, it must be admitted that we will have about reached the limit when the Slauson Avenue wells and the group below the old conduit diversion of the river are exploited."

Facing this condition, which beyond question is a true statement of the facts, we here present the result of our investigations of the amount and availability of other supplies, preceding which, however, we present a review of the growth and development of this and neighboring towns in the past, together with graphical diagrams intended to be prognostic of the future population and its needs in the way of water supply.

Fortunately the collection of data for our purposes was much facilitated by the scientific and thorough work of the United States Geological Survey Department, which, recognizing the great economic importance of water in this region, made painstaking and elaborate investigations of the resources of the country in this vital particular.

In addition to this reliable source of which free use was made by us, there is extant in the records of Southern California a vast amount of information that was originally collected for use in the many fiercely contested lawsuits affecting water rights throughout Southern California and which alone have given hydraulic engineers of this country an exceptionally accurate knowledge of the limitations of its water supply.

GEOLOGY OF COASTAL REGION.

To facilitate a more complete appreciation of the physical conditions which govern the present supply, a map (see accompanying folio of Exhibits) has been prepared, showing the controlling mountain ranges, the principal valleys, the drainage courses and their water sheds.

A glance will suffice to show the position of Los Angeles with relation to the Sierra Madre range on the northeast, the San Fernando Valley and the Los Angeles River on the northwest, the San Gabriel Valley and River on the east and the Coastal Plain on the south. The geographical location of our city is thus seen to be most favorably situated with relation to the

development and use of the waters of the San Fernando Valley, and were it not for the material considerations discussed later in this report, it might be supposed that we could best augment the city's water supply by utilizing the waters of the San Gabriel River and the Artesian Basins of the Coastal Plain to the south.

A short discussion covering the essential features of the Geology of the surrounding districts may assist in a clearer understanding of the hydrographic conditions bordering Los Angeles.

In the northeast, by reference to Exhibit No. 1, we notice the lofty range of the Sierra Madre Mountains. It is here that the waters of the Los Angeles and San Gabriel Rivers have their origin. The Los Angeles River is not indicated as rising in the Sierra Madres, but, as its waters are almost wholly due to the conservation and storage in the extensive valley gravels of the storm runoff from the mountain slopes during the periods of heavy rainfall, it can with propriety be stated that the river originates in the Sierra Madre Mountains.

In past ages all of the country lying between the main coast range and the ocean has been submerged. The higher range of mountains north of Los Angeles is approximately paralleled by a range of hills extending from the Santa Ana Mountains westerly to the coast just north of Santa Monica and thence following up the coast. This range east of the San Gabriel River is known as the Puente Hills and west of Los Angeles as the Cahuenga Mountains. There are several minor groups of low mountains interspersed between these parallel ranges and they limit and form the rather extensive valleys of the San Gabriel and San Fernando.

South of the Cahuenga Mountains and Puente Hills we find a broad area of 776 square miles extending practically to the ocean. Its gently sloping surface is only interrupted by the low range of hills adjacent to the present coast line. This slight uplift is indicated at its eastern extremity by Signal Hill, north of Long Beach. Its westerly extension passes just south of the Palms.

At the most southerly limits of the Coastal Plain between San Pedro and Redondo we find the Palos Verdes, a range of hills attaining an altitude of 1800 feet above the sea level and forming a buttress in the present shore line. In past ages the ocean had free access around the base of these hills and at that time they formed one of the present group of Channel Islands. That the ocean once covered the land north of the Palos Verdes, and in fact all of the Coastal Plain, is clearly demonstrated by finding marine deposits such as shells, bones and fish, fossilized Mollusca, etc., not only on the surface of the valley but on the mountain slopes at considerable elevations.

Many certain facts may be deduced by a study of the products brought to the light of day in the sand buckets when artesian waters are sought for at considerable depths. In this manner Nature's handwriting most eloquently portrays the titanic forces which have been exerted in ancient times, when portions of the earth, now covered by hundreds of feet of alluvium, enjoyed for a period the benign effect of life giving solar influences. The well drillers' records in this neighborhood contain entries of numerous pieces of bark brought forth, pine logs encountered and peat beds penetrated, at depths varying from one to seven hundred feet. The gravels in the Bouton Artesian Wells brought up from 750 feet below the present surface of the ground are indicative of

fresh water surface deposit. These incontrovertible facts demonstrate the uplifting and subsiding of the earth's crust.

It was probably during these periods that the lower ranges of hills and mountains lying between the Sierra Madre and the present shore line were formed.

It is, in fact, quite certain that at one time this lower range, as well as the valley lands, was considerably higher than at present, for it is a matter of record that the wells drilled in the break of the Puente Hills, through which the San Gabriel River finds its way, have been put down several hundred feet below sea level without encountering bed rock. This fact would indicate that when the channel was cut out originally it must have been at an elevation above the sea and at some later date subsided to its present elevation.

That the mighty contractions of those early days were not continuous and uniform is also well marked. Some localities were subjected to a buckling or folding of the strata in greater or less degree than adjacent districts. We know that while the bed rock at the San Gabriel Narrows is now below sea level, that the bed rock in Los Angeles Narrows is some two hundred feet above the ocean, while again farther up the San Fernando Valley borings have been reached below sea level and not encountered bed rock.

Probably the local disturbances which produced the greater elevation at the Los Angeles Narrows, accounts in a manner for the clay deposits in the depths of the valley above the Narrows.

It is a well known fact that torrential storms in the mountains producing erosive action carry great quantities of detritus into our valleys. The law of gravitation effectually regulates the deposition of the flood materials; where the torrent bursts from its mountain canyon there we find the great boulder masses, for gravity has inexorably demanded their retention as the first result of decreased velocity. In a like manner we find as we progress into the valleys a decreasing size of deposited material, until when some obstruction is reached and the waters form into great reservoirs or lakes, there we find beds of fine alluvium growing in density as depths are penetrated. This is but an illustration of the San Fernando Valley conditions and the damming up process was produced by the compression in the earth's folds now evidenced at the Narrows, where the bed rock as noted above is over two hundred feet higher than the valley bed rock.

In these commercial days few of us stop to realize the kindly hand Mother Nature has been extending. We grasp the opportunity, utilize the product and consider not its origin! At our doors we find an extensive valley in which the ages have been patiently laboring: first building a great dam, then storing up the mountain debris and conserving in it that precious fluid without which our land of plenty and prosperity would indeed be a desert country.

The crustal movement resulting in the anticlinal fold of the Cahuenga and Puente Hills and producing the catchment areas of the San Fernando and upper San Gabriel Valleys, was duplicated in a minor degree in the uplift heretofore noted as extending northwesterly from Signal Hill near Long Beach. The structural details of this Coastal Plain and the resulting artesian waters, will be treated later in this report in a special chapter. Suffice it here to say that the agencies forming the upper valleys have in natural order been productive of the artesian basins of the lower coast.

UNDERGROUND WATERS BEING DEPLETED.

The importance of the underground water supply in Southern California being recognized by the U. S. Geological Survey, Mr. W. C. Mendenhall, Geologist, was detailed to this work. The results already obtained by Mr. Mendenhall demonstrate the value of the investigation carried on by his department. The following data relative thereto has in large part been collected by him. Nearly every well south of the Sierra Madre Mountains has been inspected and the elevation of its water plane together with its output has been ascertained. The records in almost every case demonstrate the general lowering of the underground waters and the decreasing of the areas of the artesian basins.

In 1898 there were 375 square miles of valleys south of the Sierra Madre Mountains from which artesian waters could be obtained. In six years this area has decreased 33½ per cent and in addition to the decrease of area there has been a very material decrease in the flow from the wells within the present limits of the basins. Numerous individual instances could be cited, but one or two perhaps will suffice. A well just above San Bernardino, when completed in June, 1892, flowed five million gallons per day. It has decreased 95 per cent in output in six years. The famous Bouton well near Bixby, bored in 1899, yielded about four million gallons per day. On May 13, 1903, this well only flowed at the rate of 828,000 gallons per day, a decrease of 80 per cent. Almost every locality has numerous records of wells which once flowed, then ceased, and in which the water now stands many feet below the top of the casing. The former perennial streams of our lower valleys originated largely in certain ciénegas which denoted artesian basins. The falling off of the flow from the artesian wells has been followed by a notable decrease in the surface output of those streams leading from the ciénegas. Take the San Bernardino Basin as an illustration. The records of the Geological Survey show that in September, 1898, the surface flow, rising from the gravel beds above Colton, was 78 cubic feet per second or 3900 miner's inches.* In five years the surface flow has decreased to 46 second feet or 2300 miner's inches, a falling off of over 40 per cent.

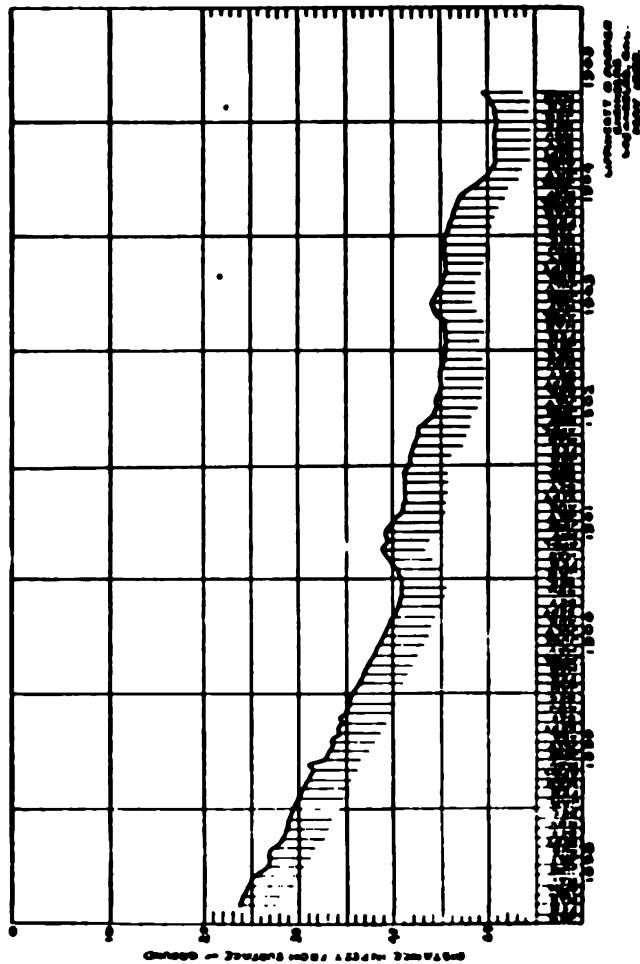
The statement that the streams of Southern California, rising from the gravel beds, may eventually be decreased to such an extent that there will be no surface flow except during torrential storms, is not intended as pessimistic, but the seriousness of the situation as it exists today and the results of various investigations should be faced.

The governing factor in the location of the Southern California towns was the proximity of perennial waters. An abundant water supply is absolutely essential to the progress and expansion of both city and suburban life. That this fact was recognized by the Mission Fathers is clearly demonstrated and the growth of the towns of Southern California has been in almost every case directly proportional to the abundance or scarcity of its water supply.

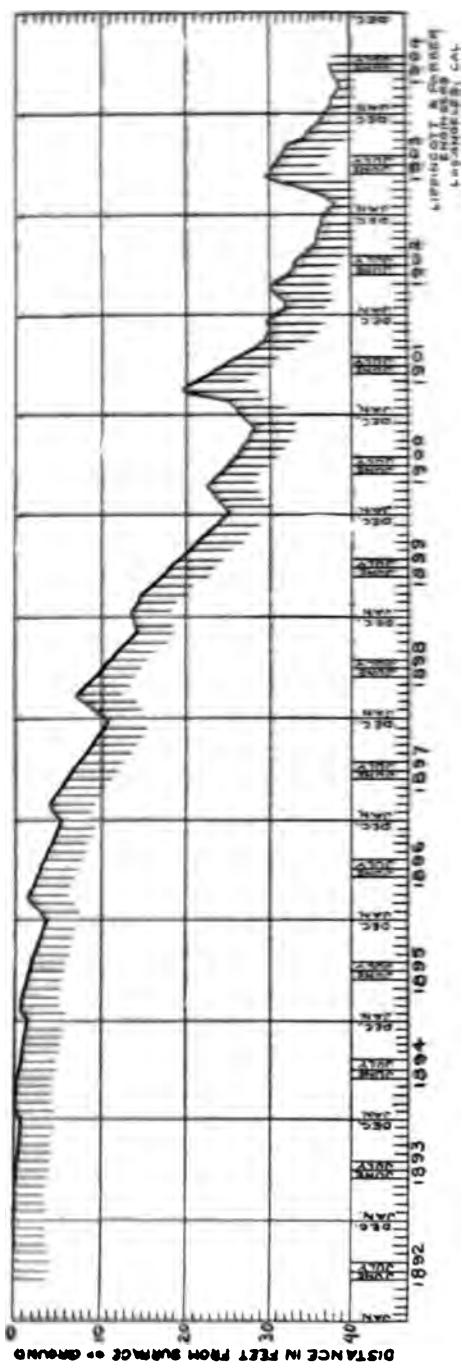
While the artesian basins have been decreasing in area and output, a general lowering of the water plane throughout all Southern California has been taking place. This is of course more pronounced in some localities than in others, depending on numerous natural causes, as, proximity to stream channels from which the gravel voids are filled, porosity of soils, relative location

*U. S. G. S. Water Supply paper No. 59, page 47.

Long Beach City Water Works
Diagram showing Variation of Water Level
August 18 Oranges Co., Cal.



Los Angeles City Waterworks
Diagram showing Variation of Water Level
in Williams Well San Bernardino Valley
California



in basin, whether at its upper or lower rim, etc. The Government records show many instructive examples of the lowering of the water plane. A few citations here of wells which are not exceptions but merely general in character, may be interesting. The water in the Johnson well, located north of the city of San Bernardino, has lowered from fifteen feet six inches below the ground surface in June, 1899, to forty-five feet below in June, 1904. In one well near San Dimas the water plane has fallen 65 feet in four years. In the well of J. B. Neff of Anaheim in March, 1898, the water stood 23 feet below the surface of the ground, and on August 1, 1905, it was 52 feet 7 inches. The Williams well near San Bernardino flowed over the casing in 1893, while last year the water stood 38 feet below the surface of the ground. Many instances similar in character could be cited, but those noted above will suffice to demonstrate the seriousness of the depletion of our underground supply. Almost every rancher who has been depending on pumped water for the vitality of his orchards has realized the decline in the plane of saturation not so much because of the decrease in volume of the supply but because of the increased cost.

CITY DEMAND AND SUPPLY.

It has become fully recognized, by students of this problem, that the limit of the present available water supply for the city of Los Angeles is being approached. This is also true of Hollywood and Pasadena. This may be too strong a statement to readily accept, but investigations of the past ten years in connection with data previously compiled, so forcibly present facts that a conclusion differing from the above can only be arrived at by assuming that nature will in some bounteous and providential way come to our rescue. Should we have a series of wet years in which the rainfall is above the average, the necessary withdrawals may be made from the gravel beds without lowering the water levels, but even with an uninterrupted sequence of wet years the growth of our city and its surrounding territory if continued in a ratio at all similar to the years just passed, will demand all of the water which can be developed from our present sources, and that, without allowing a surplus for the recharging of the already depleted underground sources of supply. On the other hand, should nature continue her delinquency for another series of years similar to those of 1907-09 we can surely anticipate a shortage, unless all development and progress, both commercial and agricultural, cease. The third annual report of the Board of Water Commissioners of the City of Los Angeles, dated November 30, 1904, shows that there were three periods during the summer of 1904 when the water consumption of Los Angeles exceeded the supply by nearly three and one half million gallons per day. The report further states that "it was only by appealing to the people through the press and otherwise, to practice the strictest economy" that the consumption dropped sufficiently to allow of filling the domestic reservoirs again. The same report states that the city's supply was only endangered during the three extremely hot periods and that the minimum supply was equal to the maximum withdrawals at all other times, but that the margin left after supplying the amount actually essential for domestic use did not permit of any water for the Park lakes during that season of the year. Again quoting from the report mentioned above: "In former years when such heated terms occurred it was

only to carry on water transportation traffic on the surplus water that was originally used for irrigating purposes, but the whole flow of the stream is now diverted to irrigation use, and the canal system abandoned. This caused a great loss of water, so many fine orchards delta and orchards within the city, and many inefficiently accepted the inevitable and relinquished the rights of their water preferences and held for over a century."

These are the conditions obtaining in the summer of 1904, and since that time there has added yearly twenty thousand people to her population. Despite the extreme hot weather conditions of temperature and season three million gallons of water daily. During the hot summer months this will mean an increase of between fifteen million gallons per day.

The city is continually going with the increased demand by water leveling off the river bed at a stage of water one hundred feet above the south boundary of the city, and about a mile upstream, and the water in the river bed just below where the water is leveled off has silted up. If the city is driven to a standstill and nothing done to relieve a present existence of existing interests there will be no future.

This is the situation, and more than the attention to remote supplies, for, as we have seen, the water conserving country is in about the same dilemma as the city of Los Angeles, and the grave problem confronts us if seeking to meet it. Let us bear in mind that the construction of works of irrigation and water supply requires the labor of years, and it will not be too much to say that even if the river itself, should we have rain enough to fill it, could furnish an additional supply of nearly twenty million gallons daily.

It must be remembered that the meteorological observations in this country began only in 1876, and systematic observations of the runoff of streams and the weather patterns, far as they may be regarded as accurate, are but in their infancy. Bearing in mind the present low stage of our water supply, and especially the dry soil, and consequently a slight degree of pessimism, let us proceed to consider the safe side.

The many casual communications to the press offering suggestions and advice on the water supply, while undoubtedly well meant, are manifestly the contributions of people who are wholly unfamiliar with the hydrography of the part of the state. For instance, the advice so frequently tendered here to the mountain people back of knowledge of the fact so well known to all of us that the small mountain stream of the slightest importance within a certain distance from the city has been appropriated long ago and that on the death or prolonged illness streams are among the first to dry up, compelling the owners who have rights in them to resort to pumping from the ditch or the valley to keep their orchards from perishing."

(Editor's Annual Report of Board of Water Commissioners of Los Angeles).

RAINFALL IN LOS ANGELES AND MOUNT LOWE.

September, 1904, to September, 1905.

	Los Angeles	Mt. Lowe.
September, 1904.....	.28	1.50
October, " .....	.69	
November, "	1.38	
December, "	2.45	1.98
January, 1905.....	2.57	4.02
February, "	6.06	12.53
March, "	6.00	10.56
April, " .....	.35	1.07
May, " .....	.95	4.01
June, " .....	.00	.00
July, " .....	.00	.00
August, " .....	.00	.00

FUTURE REQUIREMENTS OF THE CITY AND SUBURBAN TOWNS.

While the existing water supply may be sufficient to meet the present demands of Los Angeles, the future development and prosperity of the city is dependent not only on an adequate domestic supply to meet its own growing need but also for those of neighboring municipalities and agricultural lands.

For the purpose of making an estimate of the future growth of Los Angeles, Exhibit No. 2 has been compiled, the horizontal scale representing the years as indicated, the vertical scale showing the population. On this diagram the city's past population from the year 1880 is represented in four ways: (1) by the estimate of the Los Angeles Chamber of Commerce, (2) by the United States census, (3) by the estimate based on the number of water service connections in use and (4) by the estimate based on the city school census. It is found that the city had quite a uniform growth between the years 1880 and 1900. Since the latter date it has been more rapid, the population being about 200,000 at the present time. Projecting the average rate of growth for the years 1895 and 1905 inclusive into the future, we find that Los Angeles should have 250,000 people in 1912; 320,000 in 1918 and 390,000 in 1925.

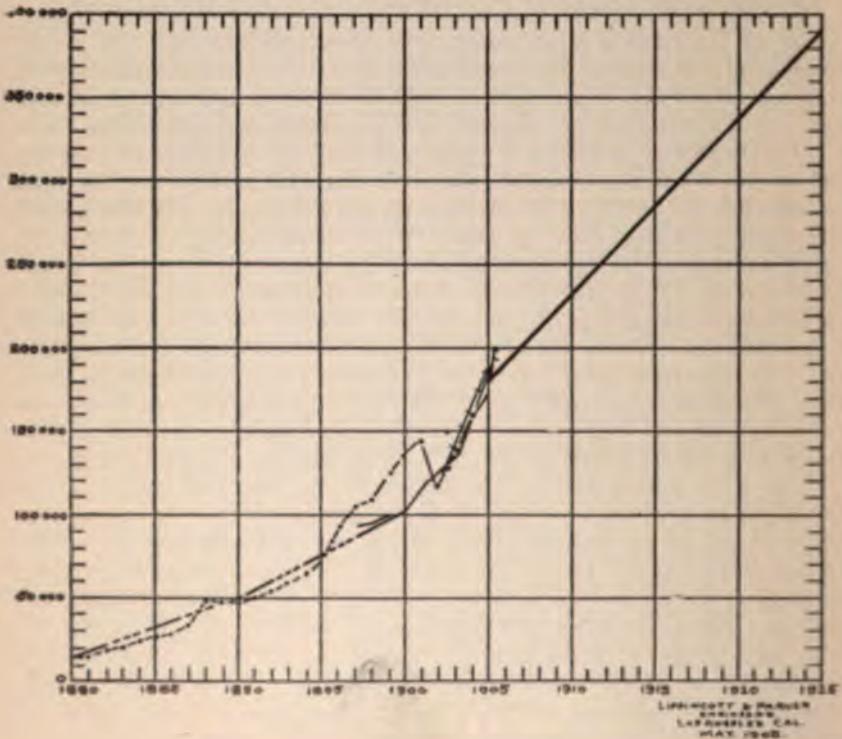
The water consumption of Los Angeles in the past has been in excess of 300 gallons per capita, but by the partial metering of the city this amount has decreased to 190 gallons, and it is believed that this quantity can be further reduced to 150 gallons per capita by complete metering without any hardship on the consumer or injury to the beauty of the extensive lawns and gardens. This consumption of 150 gallons per capita is 25 per cent greater than the average consumption of 47 cities in the United States ranging in population from 40,000 to 400,000 for the year 1900.* It is not an unusual consumption for California towns. Therefore 150 gallons per capita per day is accepted as the basis of estimates for future needs. With a population of 390,000 in 1925, Los Angeles will require a daily supply of 58,500,000 gallons or 90½ second feet, 1 second foot being equivalent to 648,000 gallons per day, or 50 miner's inches.

*Report of the Board of Water Commissioners for Los Angeles, 1902.

Los Angeles City Waterworks
Diagram showing Increase in Population
CITY OF LOS ANGELES CAL.

According to the following

Los Angeles Chamber of Commerce	denoted	—
U.S. Government Census	—	-----
Computed from City School Census	—	-+---+
Computed from Water Dept. Service Connections	—	+-----+
Estimated Growth	—	—



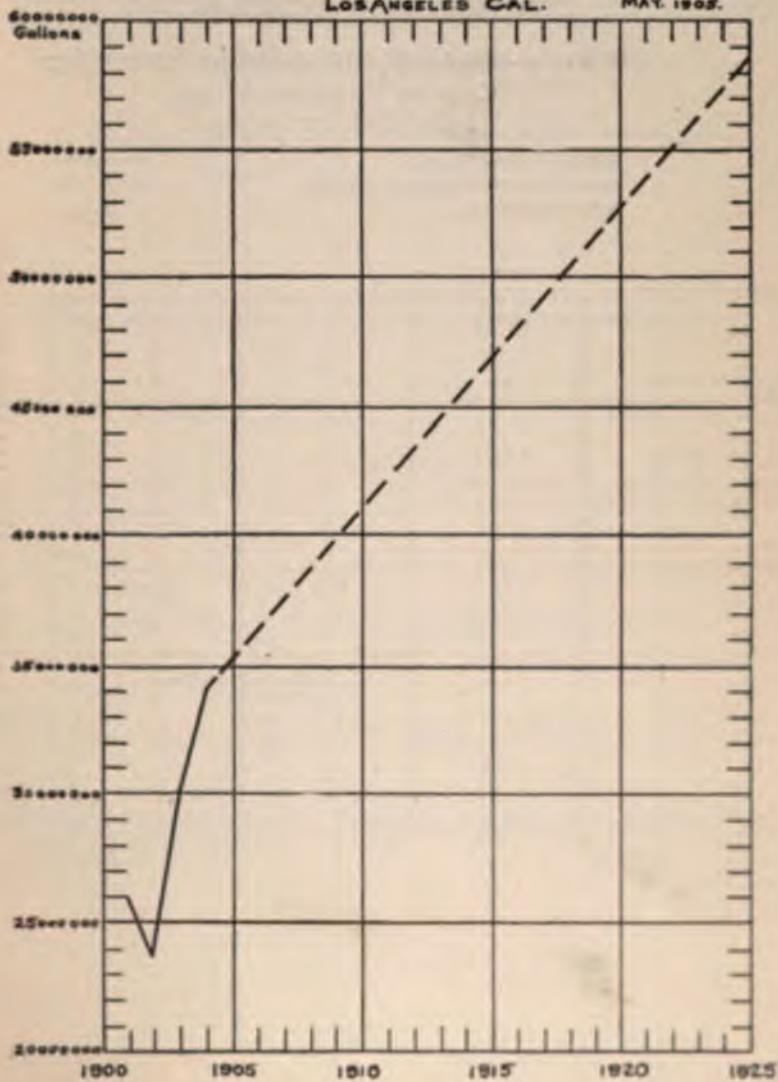
LINNEMAN & REED
ENGINEERS
LOS ANGELES CAL.
MAY 1935.

Los Angeles City Waterworks
Diagram showing amount of Water consumed
IN THE
CITY OF LOS ANGELES CAL

Amount of Water Consumed - denoted —
Estimated Future Consumption " " - - -

LIPPINCOTT & PARKER
ENGINEERS
LOS ANGELES CAL.

MAY 1905.

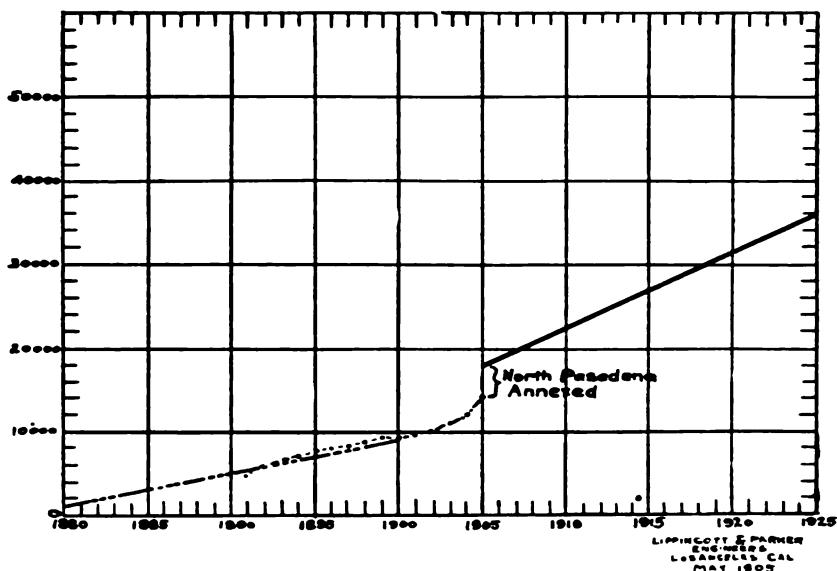


Los Angeles City Waterworks

Diagram showing Increase in Population
CITY OF PASADENA CAL.
According to the following

U.S. Government Census
Computed from City School Census
Estimated Growth.

—
- - -
—



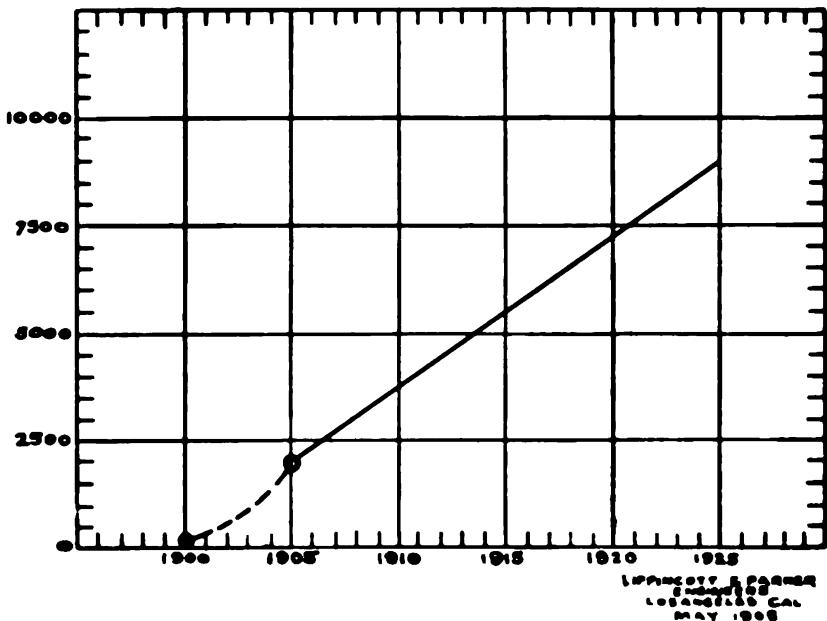
LIPPINCOTT & PARKER
ENGINEERS
LOS ANGELES, CAL.
MAY 1905

Los Angeles City Water Works

Diagram showing Increase in Population
HOLLYWOOD CAL.
According to the following

Estimated Growth

denoted - ——



Diagrams showing the past population and estimated future growth similar to that of Los Angeles have been compiled for the suburban cities of Pasadena and Hollywood. An estimate based on the school census of Pasadena indicates that the city has a present population of 18,000 (see Exhibit No. 4). Projecting the average rate of growth for the years 1895 to 1905 inclusive into the future it is assumed that Pasadena will have a population of 36,000 in 1925.

The rapid growth of Hollywood has been remarkable, having developed in less than five years from a community of about a hundred people to a prosperous town of 1800 inhabitants, with every opportunity for continued prosperity under an adequate water supply. This rapid increase of population in so short a time tends to make a prophecy hazardous, but the rate of growth for the last five years indicates that Hollywood may have a population of 9,000 in the year 1926.

The per capita consumption of these suburban cities up to the present time has been extravagant, partially due to the extensive lawns and gardens and the absence of meters. The new domestic demand due to the subdivision of irrigated orchards will in turn require an amount of water fully as great as the horticultural consumption. The present per capita consumption in Pasadena is about 300 gallons per day, notwithstanding the fact that meters are used extensively. A rate of 200 gallons is made the basis of estimate for future consumption for both Pasadena and Hollywood. With a population of 36,000 inhabitants in 1925 Pasadena will require 7,200,000 gallons per day or 11.2 second feet. Hollywood, with an estimated population of 9,000 in 1925 will require 1,800,000 gallons per day or 2.8 second feet.

Irrigation is practiced wherever a water supply is available for any of the agricultural lands surrounding the city. Precarious supplies for higher elevations are principally obtained from tunnels in the mountains. In the lower districts the artesian and ground waters are drawn upon. In this manner limited irrigation has been practiced in the San Fernando Valley in the vicinity of Burbank and Fernando and from Pasadena and Monrovia to the Narrows of the San Gabriel River below El Monte.

REQUIREMENTS OF SUBURBAN LANDS.

The total area of first class land on the Pasadena Mesa from Pasadena to Duarre, and not including the city of Pasadena, is 19,520 acres; from Alhambra and San Gabriel east to the San Gabriel River, 23,680 acres, a total of 43,200 acres. Of this land less than one-fourth is now under irrigation. In the San Fernando Valley between Eagle Rock and Burbank there are 13,440 acres, of which about one fourth is now irrigated. Above Burbank in the San Fernando Valley and La Canada Valley there are 93,000 acres of choice land with approximately 3,000 acres supplied with irrigation water. In the district between Ivanhoe and Santa Monica is an area of 40,550 acres having less than 6,000 acres under irrigation. This total area is 190,000 acres gross. Assuming a duty of 2 acre feet,* this area would require 380,380 acre feet per year or 525 second feet continuous flow, one second foot being equivalent to 724 acre feet per year.

*Enough water to cover each acre 2 feet deep each year or 1 miner's inch to $7\frac{1}{2}$ acres for six months' flow.

TOTAL PRESENT AVAILABLE SUPPLIES AND FUTURE DEMANDS.

The mean supply from the Los Angeles River for the summer of 1904 was 42.8 second feet. This is probably the minimum summer flow of this river, but it is unfortunately true that the minimum supply controls. The flow of the Arroyo Seco for dry years is taken as 2 second feet. Other sources are either insignificant or are distinctly depleting the stored underground supplies.

In 1925 we find Los Angeles, Pasadena and Hollywood will require a total of 104.5 second feet. Subtracting from the total estimated requirement of the three cities, in 1925, the supply from the Los Angeles River and the Arroyo Seco, we have 59.7 second feet or 38,385,000 gallons per day as an estimated deficit in twenty years for the towns alone. This estimate does not include the quantities developed from what may be determined as underground sources referred to in the introduction.

If the requirements of nearby agricultural lands is added to the estimated future needs of these cities a total of 585 second feet is required as the amount of water which probably could be advantageously used by the City of Los Angeles and vicinity within a twenty year period. The seepage and return water from this large area would materially assist in sustaining the decreasing water supply of the Coastal region between Santa Ana and Santa Monica.

LOS ANGELES RIVER—SAN FERNANDO VALLEY.

The San Fernando Valley because of the proximity to the city boundaries of Los Angeles and because its waters flow by gravity to the city reservoirs, is the most feasible location from which to obtain a domestic water supply. The present gravity supply is entirely from this source.

The area of the San Fernando Basin above Tropico is as follows:

LOS ANGELES RIVER WATER SHED.

	Sq. Miles
Big Tejunga	116.6
Little Tejunga	21.8
Pacoima	35.6
— —	— —
Total high mountains	174.0
Foot hills	152.9
Valleys	175.6
— —	— —
Total	502.5

The flood waters of the Little and Big Tejunga and Pacoima are discharged from their mountain canyons onto the absorbent granitic gravels of the San Fernando Valley, where they quickly disappear, forming an underground body of water having a slope to the south. This ground water coming into contact with the Cahuenga Mountains is brought to the surface, producing the Los Angeles River. Being filtered through the gravels and covered it has great constancy of flow and purity.

Precipitation records of precipitation have been kept in the mountainous portion of the basin of the Los Angeles River, as follows:

Celphy's Camp on Big Tujunga, recorded by D. W. Colby.

Maple Hill on divide between Little Tujunga and Pasadena, recorded by E. L. Hatchings.

Mt. Lowe near south crest of Big Tujunga.

Mt. Water Grist near south crest of Big Tujunga, recorded by L. V. Bowley.

Year	Thruout	Thruout	Inches	Inches	Inches	Los Angeles
1900-01			27.35	..	..
1901-02			18.48	..	..
1902-03	17.46	9.78	10.72	7.88	5.53	
1903-04	18.26	14.15	15.35	11.24	7.30	
1904-05	14.10	24.31	34.11	35.13	16.38	
1905-06	14.38		18.77	..	10.51	
1906-07			12.26	..	10.32	
1907-08			14.51	..	8.99	
1908-09			35.67	..	10.35	
Mean	17.32	15.78	20.31	18.08	12.75	

The average rainfall in the mountainous portion of the basin of Los Angeles River is believed to be in the neighborhood of thirty inches. The rainfall of the valley for the last twenty-five years is slightly less than sixteen inches.

No systematic measurements have been taken of the flow of the mountain streams tributary to this valley, but if we use the runoff per square mile as measured for the San Gabriel River, which basin is in the same range adjoining the Tujunga and Pasadena basins, and apply this ratio to the high mountains of the San Fernando Valley Basin, a close approximation will be obtained. The runoff per square mile of the San Gabriel River is as follows:

DISCHARGE PER SQUARE MILE OF THE UPPER SAN GABRIEL RIVER.

Season.	Per Sq. Mile.
1898-99	1604
1899-00	176
1900-01	120
1901-02	145
1902-03	140
1903-04	122

Supplementary.

Applying these figures we find the total discharge from the high mountains of the San Fernando Valley to be as follows:

ESTIMATED DISCHARGE OF THE MOUNTAIN BASIN OF THE LOS ANGELES RIVER.

Season.	Sec. Ft.
1898-99	10.51
1899-00	13.22
1900-01	108.75
1901-02	23.75
1902-03	130.15
1903-04	31.67
	—
Mean	53.34

The estimated mean discharge for these six years is 53.34 second feet. The westerly two-thirds of this San Fernando Valley and practically all the foothills surrounding the valley, because of the different character of the soils and rocks, do not contribute to the flow of the Los Angeles River except in flood discharge through the Narrows during the winter. The summer flow of the Los Angeles River, therefore, is practically all supplied indirectly from the flood discharge from the higher mountains, absorbed by and discharged from the gravels in the southeastern end of the valley. During the past five years this summer flow, as measured near the intake of the city water system, has been 48.5 second feet exclusive of amounts pumped in the San Fernando Valley. The amount of this pumped water is estimated at 9.8 second feet for six months each year, or say 5 second feet for the year. The sum of these two is practically the same as the estimated discharge from the mountains. This indicates that the city is now deriving practically the full benefit of all the water which is discharged from these mountain canyons and that no substantial or permanent increase can be obtained either from the building of storage reservoirs therein or by the pumping of water from the gravel beds in the San Fernando Valley. Between February, 1891, and the spring of 1903, no floods were discharged from these mountains of sufficient volume to cross the San Fernando Valley into the Los Angeles River and to wash out brush dams in the river bed at the narrows.

The City of Los Angeles owns the right to all the water of the Los Angeles River which may be necessary for the needs of the city, and during the last year, 1904, it has diverted the total flow of the river, both surface and underflow. The right granted to the Pueblo has been exercised over one hundred years and the ruling of the California Supreme Court in the case of City of Los Angeles *vs.* Pomeroy states: "This right of the City is paramount and superior to the rights of the defendants in the water of the river. The defendants, therefore, have no right to so use or divert the water of the river as to diminish the same so that it will not furnish the amount needed for the supply of the City." The lands of the defendants in this instance were saturated gravel beds in the lower end of the San Fernando Valley from which they claimed the right to pump and divert water. A

similar ruling was rendered by the County Superior Court of Los Angeles in the case entitled City of Los Angeles vs. West Los Angeles Water Company.

In the last few years other owners of water bearing lands in the valley have sunk wells and commenced extensive pumping for irrigation, resulting in a marked increase in the flow of the river. It will further settle the question of such irrigators, the City has instituted proceedings in the courts to determine the rights of these waters. It is certain that if these land owners have the right to extract the water from the underground supply by extensive pumping and irrigation in the San Fernando Valley, all land owners there will have the same right and it will result in a further serious impairment of the City's supply. It was estimated a LNL that the amount thus pumped in the summer months was 44,000,000 cu. feet continuous flow. A greater quantity is now expected. The amount over this may be increased is only limited by the total flow of the river.

In view of the fact some of the City's right to the waters of the Los Angeles River may be obtained in consideration of the net earnings of the city department of the Angeles for the year ending November 30, 1904.

REVIEW OF THE LOS ANGELES CITY WATER WORKS Bills

Item	Amount
Water	\$104,375.00
Water - West Side	1,136.57
Thermite	12,540.54
Services	13,112.71
Material - in Charge	4,153.39 \$104,180.94
Disbursements	
Maintenance	4,152.16
Pumping	101,481.77 105,633.33
Less Depreciation, December	15,300.30

Less Depreciation, November	1021.428.17

\$1021.428.17 capitalized at 1 per cent = \$10,214.282.10 or \$8,000.00 per M. C. of water of 1,000 M. C.

This water supply which we find necessarily at our doors, the rights of the City to which has been confirmed by numerous court rulings, the water being distributed through our system by gravity, is undoubtedly the most valued possession which the City holds. It should be preserved with the greatest vigilance, as any other water supply may be retained. Any other source which can be had at a reasonable cost by dug and expensive wells, should be utilized in necessary to the City to maintain its rights under all circumstances, without fear of conflict. The extraction of water for irrigation purposes in the San Fernando Valley, or by storage in the reservoirs will seriously impair the flow of the river. The most rational and legal solution of the problem is to obtain a San Fernando Valley land company to appropriate to purchase a new supply. It is to the interest of the City to aid in their development.

The mountains surrounding the San Fernando Valley are in a forest reserve and practically without inhabitants. The valley itself in most parts is settled by ranchers. The upper portion of the surface stream of the Los Angeles River adjacent to the settled districts requires more rigid protection against pollution.

The immense deposits of gravel brought down from the mountains in past ages, filling the San Fernando Valley to a great depth act as a natural regulator to the mountain floods, largely absorbing the water before it has passed through the valley, otherwise the regimen of the Los Angeles River would be similar to the intermittent flow of our mountain streams, dry in summer and subject to floods during the winter rains. In contrast to these mountain streams, the Los Angeles River at the Narrows has a very constant flow, but is none the less dependent both upon the flood water from the mountains and the maintenance of the water levels in the valley.

As measured at the Los Feliz narrows in former wet years the average flow of the Los Angeles River was 75 to 80 second feet. The scant rainfall of the past decade coupled with the pumping of the underground water for irrigation in the San Fernando Valley has resulted in a steadily decreased flow. in 1899 the mean summer discharge was 57 second feet, in 1900 53.5 second feet, in 1902 43 second feet, in 1903 44 second feet, and in the summer of 1904 the flow of the river had fallen to 42.6 second feet, giving a mean for the past five years of 48.5 second feet. While the supply from the river has been steadily decreasing, the city's population and its demand for water has been rapidly increasing until a consumption of 52.6 second feet was reached in 1904.

That the flow of the Los Angeles River does not make any sudden responses to a single season of plenteous rain is proven by the winter of 1902-03, when with a rainfall above the average the flow of the river was less than during the preceding year which had scant rainfall. It is only by a series of wet years succeeding each other that we can hope to find the water plane in the San Fernando Valley materially increased in elevation with a consequent substantial increase in river discharge.

A table showing the measurements of the Los Angeles River for the summer and fall of 1904 is sufficient to show its constancy.

FLOW OF THE LOS ANGELES RIVER IN 1904.

Month.	Second Feet.
April 15.....	46.77
May 25.....	47.84
June 18.....	45.43
" 24.....	40.35
" 27.....	42.60
July 19.....	42.19
Aug. 9.....	40.32
" 16.....	40.63
Sept. 7.....	40.16
" 20.....	40.15
Oct. 25.....	43.02
Nov. 18.....	43.29
Dec. 29.....	42.96

The mean flow was 42.82 second feet, while the maximum observed flow was 47.82 second feet, as measured on May 25th, or 11.7 per cent above the mean flow. The minimum flow was 40.16 second feet, measured September 7th, or 6.2 per cent below the mean flow for the period of observation.

From the foregoing measurements and considering that the minimum flow of the river controls the amount available for domestic use, the mean summer flow of 1904, namely 42.8 second feet, is taken as the controlling supply the City of Los Angeles can rely upon from this source. The deficiencies are made up by pumping below the narrows. In this report this surface stream available at the Los Feliz narrows is considered as the amount that can be relied upon with certainty and is the basis that is used in this report. It has been shown in the introductory statement that the amount that may be pumped into the mains is material, but in broadly providing for the future as is here contemplated, it is deemed best to eliminate the amounts extracted by pumps from the gravel beds. However, the water that is obtained from the tunnels at the Buena Vista pumping station during the summer months, estimated at 9 second feet, is a supply that is believed to be of quite a reliable nature.

LOS ANGELES RIVER—TEJUNGA TRIBUTARY.

The Tejunga is the largest of the mountain tributaries emptying into the San Fernando Valley. Its source is in the Sierra Madre Mountains at an elevation of nearly 7,000 feet. Flowing nearly due west Tejunga Creek emerges from the mouth of the Tejunga Canyon about sixteen miles north of the city of Los Angeles at an elevation of 1,500 feet. The area of the basin above the mouth of the canyon is 116.2 square miles. The formation of the water shed is of a granitic character timbered in the upper portion and having a growth of underbrush in the lower elevations. The rainfall probably averages 30 inches annually for the basin. A very close approximation of the total discharge may be computed by applying to the area of the Tejunga Basin the runoff per square mile as observed in the adjoining water shed of the San Gabriel River. This indicates:

ESTIMATED DISCHARGE OF THE TEJUNGA.

Season.	Sec. Ft.
1898-99	7.02
1899-00	8.83
1900-01	72.62
1901-02	17.20
1902-03	86.80
1903-04	21.15
— —	
Mean	35.60

An organization, known as the Los Angeles Mountain Water Company, has surveyed a number of reservoir sites on the Tejunga. An application has been approved by the Secretary of the Interior for right of way for one of these reservoir sites situated about two miles above the mouth of the canyon.

According to the maps filed in the United States Land Office, the area of the proposed reservoir with a 70 ft. dam is 40 acres and the capacity 1,444 acre feet, or a volume sufficient to supply 2 second feet (100 miner's inches) continuous flow for one year.

Rough estimates have been made, for purposes of comparison, of two of the best reservoir sites filed upon by this company, but not approved by the Secretary of the Interior. One of these is situated in the upper Tejunga and has a drainage area of 38.7 square miles. The other has a water shed of 87 square miles. As far as known only meagre surveys have been made of these sites, the top contour only having been run. With a maximum depth of 70 feet at the dam, the capacity of each reservoir is slightly less than 2 second feet continuous flow for one year. An amount that could give no material relief to the situation under consideration.

The estimated runoff that is available for the upper reservoir with a drainage area of 38.7 square miles is here given:

Season.	Sec. Ft. Available.
1898-99	2.34
1899-00	2.94
1900-01	24.19
1901-02	5.73
1902-03	24.91
1903-04	7.04

The supply available for the upper of these reservoirs would have been sufficient to fill it during the past years of minimum rainfall, and the water supply would be much greater for the lower reservoir.

An approximate estimate indicates that for a dam at the upper reservoir site and a pipe line across the mountains through the La Canada Valley and along the edge of the San Rafael Hills to the Garvanza Reservoir, the cost would be over \$9,000 per miner's inch. The diversion line is 20.4 miles; the first 13 miles through a rough and inaccessible country. The estimated cost per thousand gallons for water from this source, including operation and maintenance, is about 17 cents.

A less costly proposition is to bring the water from the reservoir site approved by the United States Government, in a diversion line, through the San Fernando Valley to the present headworks of the domestic supply of the City of Los Angeles. This lower line would be through the San Fernando Valley 16.4 miles in length. The approximate estimate indicates a cost of \$8,000 per miner's inch, and including operation and maintenance over 14 cents per 1,000 gallons.

The above estimates are sufficiently close to permit of conclusions as to the value of a supply from this source.

Another and more important point in the consideration of an additional supply from this source, is that the Tejunga Basin represents 63 per cent of the total mountain water shed of the Los Angeles River and by cutting off any portion of the runoff of the Tejunga Basin the flow of the Los Angeles River is depleted by approximately that amount. While this estimate is considered, it is not of importance, except in a negative way.

SAN GABRIEL NARROWS.

Like the Los Angeles River the San Gabriel discharges from its mountain canyon near Azusa onto extensive gravel beds above El Monte. The San Gabriel has also a well sustained summer flow at the mouth of its mountain canyon which is diverted for agricultural purposes, along the foothills. Perhaps thirty-three per cent of the water which is used for irrigation sinks into the ground to augment underground supplies, the remainder being lost by evaporation from the surface of the soil and in plant growth. As in the case of the Los Angeles River the winter floods which are discharged from the mountain canyons are rapidly absorbed as they proceed on their way over the loose gravel beds which extend from the Azusa to El Monte. Probably two-thirds of the total annual discharge from the high mountains sinks into the gravel beds above El Monte. The ground waters thus formed move toward the lower narrows on a grade approximating the surface the depth to water being greatest near the mountains.

The San Gabriel Valley is almost closed by a secondary range of foothills forming a Narrows between El Monte and Whittier. The contraction of the valley interrupts the underground flow and checks it so that it appears as a surface stream of marked constancy much resembling the Los Angeles River.

There is focused into these Narrows the underground waters and runoff from the following areas:

SAN GABRIEL DRAINAGE BASIN ABOVE LOWER NARROWS.

High Mountain including San Gabriel proper..	222.00
Adjoining basins	98.80
Foothills	60.42
Valley	185.51

Total	566.73

The high mountains are mostly granite, covered with brush and in the high altitudes with timber. These higher districts are all included in the San Gabriel Forest Reserve. The foothill ranges consist of sedimentary rocks unoccupied and bare of forest cover. The valley formed by the deposits brought down from the mountains is highly developed agricultural land, occupied not alone by farmers but by many towns which are scattered throughout the territory. It is believed the same discharge per square mile, as measured for the 222 square miles of basin above Azusa during the last eight years, would apply to the total mountain area of 320.8 square miles above the Narrows. Upon this basin the following table has been prepared: the discharge is given in acre feet, 1 acre foot being equivalent to 43,560 cubic feet, or enough to cover one acre one foot deep with water.

ESTIMATED DISCHARGE OF THE SAN GABRIEL RIVER.

Year.	Inches	Acre ft.	Sq. mi.	Two-thirds of total runoff		
				San Gabriel above canyons 222 sq. miles	Total Mts. 222 sq. miles	Total ft.
1896	11.80	24,349	33,185			23,457
1897	14.28	96,270	139,114			92,743
1898	4.83	15,697	22,643			13,122
1899	11.30	10,489	15,157			10,105
1900	8.69	21,986	31,771			21,181
1901	11.96	38,606	128,040			85,360
1902	13.12	22,312	32,242			21,181
1903	14.77	106,985	154,598			103,065
1904	11.88	26,836	38,779			25,853
1905	19.35	...	...			...
Mean	12.20	45,948	66,396			44,265
			(or 63.46 sec. ft.)	(or 91.71 sec. ft.)	(or 61.14 sec. ft.)	

No estimate has been made of the probable discharge from the foothill and valley lands, but doubtless some of the rain falling thereon will sink into the soil to augment the water supply. Of the discharge from the mountain area of the San Gabriel River an unknown portion will pass through the Narrows and be permanently lost during the flood discharges of wet years. This amount however, is not believed to be very great during cycles of low precipitation because of the absorbent character of the gravel beds, between Azusa and the Narrows, over which the flood waters must pass, for a distance of about fifteen miles. For the purpose of an estimate it may be assumed that fully two-thirds of the stream flow from the mountains is regulated through the gravels and delivered at the Narrows. The average two-thirds of the total mountain runoff is 44,265 acre feet per year or 61.1 second feet. It must be remembered that this period of observation has been one of drought, as denoted by the rainfall records.

The total summer flow of the upper San Gabriel River at the mouth of the canyon is diverted by canals and used for irrigation purposes in the vicinity of Azusa and Covina. The land in the vicinity of El Monte, just above the Narrows, is largely planted to alfalfa, vegetables and walnuts, which require extensive irrigation. Water is pumped from 49 wells in this locality, and the estimated combined output is 3,096 miners inches, or 62 second feet, which is extracted during the irrigation season, or say for one half the year.

It is impossible to say what the volume of water is which may be extracted from this district, but it is large. This location is peculiarly favored both because of the large water supply annually delivered thereto, the great area of absorbent river gravels and the advantageous topographical features.

The drainage lines between the mouth of the mountain canyon and the Southern Pacific railroad are dry during the summer season. The water begins

appearing at the surface near the main line of the Southern Pacific railroad and in the two storm channels of the San Gabriel River. One pumping plant located a mile north of the Southern Pacific railroad has five cased wells sunk side by side twenty-five feet apart. From these five wells throughout the summer of 1898 there was pumped about 500 miners inches. Numerous other wells occur in this district where from thirty to sixty miners inches are pumped, as desired. South of the Southern Pacific railroad the water rises to the surface and the land is so moist that drainage ditches have been built around many of the fields. Land can be bought on the north side of the railroad track in this water bearing district for from \$100 to \$150 an acre. In the most favorable location for water development the cost is from three to four times that amount. A serious objection to this source of supply is its low elevation.

The following is a list of pumping plants in this district with the dates of erection and approximate output:

TABLE OF PUMPING PLANTS ABOVE THE SAN GABRIEL NARROWS.

Owner.	Year Compl't'd.	Estimated Output Miners inches
1 Orange Grove Land & Water Co....	1903	60
2 Irwindale Land & Water Co.....	1899	65
3 J. F. Irwin		35
4 Vineland Irrigation District Plant..	1898	100
5 Cypress Ave. Water Company.....	1903	56
6 P. C. Basher.....	1900	15
7 Wm. Overhaltzer	1900	23
8 C. N. Bassett	1899	135
9 E. M. Haddock	1900	90
10 W. G. Kerckhoff	1900	15
11 A. R. Evans	1899	20
12 Rincon Irrigation Co.....	1901	60
13 Rincon Irrigation Co.....	1900	110
14 H. E. Farman	1902	85
15 Paso de Bartolo Water Co.....		85
16 F. F. Pellissier		10
17 W. N. Murry	1899	15
18 E. J. Baldwin		15
19 E. J. Baldwin		10
20 W. Snoddy	1899	50
21 Alvarido Water Co.....	1899	25
22 J. Rudel Winery.....	1890	40
23 Mr. Olmstead		10
24 Harry Rose	1900	75
25 C. R. Green	1902	155
26 Frank Procter	1901	100
27 F. Pearson's Ranch	1895	150
28 J. S. Killian		200
29 Percy Ranch	1898	75

TABLE OF PUMPING PLANTS ABOVE THE SAN GABRIEL NARROWS—Continued

Owner	Year Compl'td	Estimated Output	
		Miners	Inches
30 Martin Haig & J. E. Parker.....	1898	30	
31 Martin Haig & J. E. Parker	1898	60	
32 Garvey Ranch	1898	150	
33 Garvey Ranch	1899	150	
34 Garvey Ranch	1895	10	
35 A. J. B. Immel	1902	12	
36 Ward Bros	1902	15	
37 Mr. McCloud	1904	125	
38 Ward Bros.....	1904	30	
39 E. J. Baldwin		10	
40 T. J. Wiggins.....	1898	100	
41 Jackson Frene		50	
42 Newman Ranch		60	
43 W. R. Richardson		25	
44 W. R. Dobson	1897	40	
45 T. P. Herbert	1894	60	
46 P. F. Cogswell	1902	65	
47 John Hayes	1891	85	
48 W. C. Nidever	1897	100	
49 B. W. Dancer	1894	65	
Total		3096	—

This pumped water is largely used for the irrigation of lands in the San Gabriel Valley intermittently during the irrigation season. To obtain an adequate domestic supply for Los Angeles from this source the City should buy large areas in this basin or compete with the owners of these pumping plants. It would be difficult to avoid litigation in any event.

It is doubtful if the Courts would sustain the right of the City to extract this underground water in large quantities coupled with its conveyance outside the drainage basin. The California Supreme Court decision in the case of Katz vs. Walkenshaw states,* "the common law rule that percolating water belongs unqualifiedly to the owner of the soil and that he has the right to extract and sell it is not applicable to the conditions existing in a large part of the state where artificial irrigation is essential to agriculture and artesian wells in percolating belts are necessarily used for that purpose." Under the decision in this case the rights of the land owners are paramount to those who subsequently take the water to distant localities. The subsequent appropriator may take any unused surplus.

The ranchers in the territory in the Lower San Gabriel Valley between the Narrows and the cities of Whittier and Downey claim the riparian rights to all water flowing in the Narrows and divert the total summer flow of the river into numerous ditches and canals which convey the water to their orchards and alfalfa fields. Some of these diversions are over thirty years old. The following table gives the area irrigated by each canal system of this district.

*Vol. 141, page 116.

~~ANALYSES OF WATER FROM THE LOWER SAN GABRIEL RIVER.~~

Land:	Acres.
Grass	292
Soil bottom	398
Forest	1,392
City	377
Bentonia	1,000
Agriculture	473
Lower River	388
Devotion Lake	488
Little Lake	381
Los Cerritos & Burnt	2,371
Benton	271
Lower Whittier	6,817
Wetland	347
Bottom	415
 Total Area	 17,328

The owners of those water rights would probably contest my large extraction and return removal of water from the gravel above the points where the river runs and have organized an association to oppose it. If the City attempted this diversion it would be placing itself in the position of those opponents of water in the San Joaquin Valley whom she has so vigorously fought at the Courts for the past ten years. It would be unwise for the City to allow this test and call on this question.

The following is an analysis of the water which rises to the surface in the New Gabriel River:

QUALITY OF WATER IN LOWER SAN GABRIEL RIVER.

	Grains per U. S. Gallon.	Solids per 1,000,000 parts water
Sodium chloride (common salt) .....	.32	5.6
Sodium sulphate (glauber salt)	1.48	25.7
Sodium carbonate	1.64	28.2
Magnesium carbonate .....	.94	16.1
Calcium carbonate (lime)	6.45	111.2
Iron carbonate (ferrous) .....	.20	3.5
Milieu .....	.90	15.3
Organic matter & combined water.....	.50	9.6
 Total	 12.43	 214.2

It will be noticed that the water is of exceptional natural purity, being entirely free from ammonia and relatively free from organic matter. Lime, magnesium, potassium and sodium in small quantities are not undesirable ingredients. Out of forty-eight analyses of waters of different cities of the United States which have been noted, seven have less and forty-one more solids than this water. It contains about two-thirds of the amount of mineral

salts found in the water now used by the City of Los Angeles. Water that is chemically pure is not found in nature, neither is it by any means certain that such water would, if available, best serve the purpose of domestic supply. It is the organic matter only which is to be feared in a water supply.

While the flow of the San Gabriel River at the mouth of the mountain Canyon has been as low as 4 second feet in the summers of some of the past dry years, the river at the Narrows has shown a marked constancy in both monthly and seasonal flow. There was flowing in the Lower Narrows of the river on July 3, 1898, 3000 miners inches and on August 30, 2500 miners inches. These large volumes occurred during a period of severe drought.

OBSERVED SURFACE FLOW OF THE LOWER SAN GABRIEL RIVER AND DITCHES.

July 3, 1898.

	Sc. ft.
Rio Hondo	29.79
Temple Ditch	9.06
Whittier Ditch	2.52
Baldwin Ranch House road	8.79
Original River Channel	6.18
Campers Station	3.36
Puente Ditch—50 per cent of usual head in Ditch	1.22
<hr/>	
Total	60.92

Measurements of August 7-8, 1900.

	Sc. ft.
Rio Hondo	23.28
Arroyo Ditch	21.08
Cate Ditch	8.71
Standifer & Banta Ditch	30.00
Rincon	2.47
Sheep Creek Ditch	2.46
Temple	1.20
*E. Whittier Ditch	5.71
<hr/>	
Total not including developed water	65.92

"Developed water."

Measurements of 1902.

	July 25	July 29	Aug. 18	Sept. 8	Sept. 16	Sept. 27	Oct. 11
	Sc. ft.	Sc. ft.	Sc. ft.	Sc. ft.	St. ft.	Sc. ft.	Sc. ft.
Rio Hondo			24.27	25.64		23.54	24.72
Arroyo Ditch	21.73		23.74	23.19		24.61	24.94
Cate Ditch			8.95		10.64		
Ranchoito Ditch ...			25.93		20.82		
Los Nietos Ditch ..			16.62		16.28		
E. Whittier		:			5.62		
Sheep Creek					2.09		
Rincon Ditch					3.23		
Durfee Ditch					1.28		
Point 1	3.20		3.67	0.91		2.03	1.59
Point 2	1.20		0.70	0.72		0.63	0.75
Point 4	1.93		1.19	0.99		0.52	0.61

Measurements of 1903.

	Sc. ft.
Rio Hondo	29.00
Cate Ditch	5.50
Ranchoito	14.00
Los Nietos	28.00
*E. Whittier	5.10
Sheep Creek Ditch	4.60
Rincon	3.40
Durfee	1.60

Total not including developed
water 86.10

Measurements of 1904.

	June 15	July 8	Aug. 31	Sept. 24	Oct. 5	Oct. 15	Mean
	Sc. ft.	Sc. ft.	Sc. ft.	Sc. ft.	Sc. ft.	Sc. ft.	Sc. ft.
Rio Hondo	21.96	22.97	22.25	21.65	22.19	26.97	
Arroyo Ditch	20.58	19.71	18.60	17.90		26.97	19.51
Cate					10.07		10.07
Ranchoito			14.38		12.89		13.63
Los Nietos					19.50		19.50
Baldwin 1.....	3.05	3.38	2.99	2.81	2.89		3.02
Baldwin 3	1.36	.90	.80	.93		.78	.95
Baldwin 461				.12

Total measured	67.54	66.80
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*Developed water.

The Rio Hondo is measured at the Old Mission Bridge. The Arroyo ditch makes a complete diversion below this point in summer.

The measurements of the San Gabriel River at the Narrows have been taken at irregular intervals. The large number of diversions at widely separated points makes it difficult to obtain a perfect record. By reason of the similarity in the character of the Los Angeles and San Gabriel Rivers, an approximate estimate of the flow on average and wet years at the San Gabriel Narrows can be obtained by comparison. Thus the measurements in the summer of 1904 of the Los Angeles River were 42.82 second feet, with the San Gabriel River at 67.54 second feet, on October 5th. Applying the ratio to the estimated average flow of the Los Angeles River of 59 second feet, we find the average flow of the San Gabriel to be 93 second feet. The same ratio if applied to the Los Angeles River flow in the wet year of 1891 of 81 second feet indicates 128 second feet as the supply at the San Gabriel Narrows in wet years. The flow during the summer of 1904 may be taken as a minimum which has been somewhat depleted by the extensive pumping above.

In the summer of 1902 Professor Charles S. Slichter, of the U. S. Geological Survey, made a series of measurements to determine the probable velocity of the underground waters at the San Gabriel Narrows. Tests were made at four points to depths of about 10 feet beneath the surface and velocities found of from four to forty-eight feet per day. The width of the Narrows is about 10,000 feet. Gravels are found in bored wells to depths of from 300 to 600 feet, but the formation is not uniform and some of the strata are under hydrostatic pressure, indicating little or no flow therein. Under these conditions and with these very limited tests it is impossible to make even an approximate estimate of the total underflow through the Narrows. Nevertheless, and no matter what the amount, it is probable that this underflow can not be removed without either directly or indirectly reducing the surface flow, especially if the water is taken out of the drainage basin. If it should be used in the basin above the Narrows the conditions would be somewhat modified both physically and legally.

It has been estimated that in 1925 the cities of Los Angeles, Pasadena and Hollywood will require 59.7 second feet in addition to the amount obtained from the Los Angeles River and Arroyo Seco. To obtain this from the lower San Gabriel River many rights at the Narrows would have to be condemned, as the minimum surface supply available from this source is only slightly in excess of these future estimated requirements. This might mean that the combined area of 17,500 acres dependent upon irrigating water obtained from the river at the Narrows would have to be condemned or damages paid thereon. The present value of this improved land is from \$400 an acre for alfalfa land to \$600 and \$700 an acre for orange and walnut groves, depending upon the size and condition of the trees. The value of this land at an average of \$500 an acre, which is considered to be a fair estimate, is \$8,750,000. In producing this injury to these suburban neighborhoods the City would engender bitter strife and destroy trade.

In the following preliminary estimate the cost is considered of diverting the water at the San Gabriel Narrows at an elevation of 200 feet, carrying it in a gravity concrete conduit to a point southeast of Los Angeles at an elevation of 182 feet, where a pumping plant would be installed to raise

the weight of the load, we will command the engine to move the concrete into position. The ratio of force exerted by the traction engines and high duty engines to the total amount of weight to be moved will determine the number of sufficient capacity traction engines required to be held in reserve. A pressure tape from the pump will give sufficient pressure to move the concrete. The diameter and the length of the pipe will approximate given, and is determined when sections are taken of the concrete. The estimate, including labor, is \$100000.00, and the cost of the equipment and maintenance.

...and to start and develop
the ability to think clearly
and to express this ability
with a minimum of unnecessary words as a
basis for effective communication.

THE COASTAL PLAIN.

...

The new strength of the
affiliation, the Los Angeles,
California.

the San Gabriel and the Santa Ana Rivers. The waves and currents of the Pacific have been aided in the distribution of the alluvium, and have probably made small independent additions to the Coastal Plain material, through their coastwise transporting action. Hence, actually this broad plain is formed by three large and a number of minor coalescing alluvial fans, modified along their seaward edge by sand spits, dunes, salt marshes and other normal shore phenomena. The alluvial fan form of deposition prevails along the inland edge of the Coastal Plain deposits, and is well displayed in the arroyos tributary to Santa Monica Canyon (Exhibit 6), and in those which cross the bench lands east of Los Angeles. On the other hand, convincing evidence of marine agency on the formation of some of the deposits is furnished by the shells, now found scattered over the surface of the Coastal Plain at distances from the present seashore, or brought to the surface from depths of several hundred feet by the sand buckets of the well drillers.

It is probable that during the oscillations of the land which have been such characteristic features in the evolution of the Pacific shoreline, oceanic agencies and alluvial agencies have alternated as elements in control of Coastal Plain deposition. Hence, at one time all of the present Coastal Plain has been a great bay, the waves reaching nearly to the base of hills of the Coast Range, while at other periods the shoreline has probably been much farther west than now and conditions favorable to river deposition have extended far beyond the present shore.

Character of Deposits.

But whether the streams flowed across a wide or a narrow Coastal Plain, they have been constantly depositing upon it the products of their erosive action in the higher interior mountains. These products are gravels or sands or clays, as they represent more or less active stream action. The chief characteristic of alluvium is its irregularity. Streams constantly shift their channels. They deposit one day and erode the next. They deposit gravel where they are swift and mud where they are sluggish. They cut out both when a greater flood augments their volume, or they shift to a new channel when a sufficiently powerful obstruction is encountered. Some of the changes in stream channels in the Coastal Plain are historical. The San Gabriel in 1868 shifted from an outlet by way of the Rio Hondo and Wilmington to its present outlet in Alamitos Bay. A change in the Santa Ana, which, although not historical, must be very recent, is that from the Old Wash, north of Anaheim and extending to Alamitos Bay, or Anaheim Bay, to the present outlet near Newport. It is by this constant shifting of channels that alluvial fans are built up, and it is by such processes, modified by wave action, that the present Coastal Plain has come into existence.

Artesian Conditions.

The essential irregularity of deposits formed in this way has one important modification. It is that the coarser deposits are always found near the head of the alluvial fan, and the finer deposits are always found at a distance from the head. The head of the flat coalescing Coastal Plain fans is in each case the lower end of the Narrows through which each stream reaches the Coastal Plain.

Now, fine deposits are just as essential as coarse deposits to the existence of artesian waters. Water will not accumulate head unless it is confined under a relatively impervious stratum. Relatively impervious is stated advisedly. It is not necessarily absolutely impervious. If a coarse gravel through which water can percolate rapidly is overlain by sand through which water can percolate but slowly, and both dip in one direction and have the other mechanical conditions necessary, artesian conditions will result if water is supplied with sufficient rapidity at the intake of the gravel mass. Evidently it must be supplied there more rapidly than it can leak out through the less porous overlying sand. With a small supply of water, artesian conditions will not arise, because of the escape of the small supply through the sand. If the sand is replaced by an impervious clay, artesian conditions will result even with a small supply, because the small supply is all confined.

Sufficiently fine materials to give artesian conditions are not found on the Coastal Plain near the lower end of passes through which the large streams reach it. Hence artesian waters are not and have not been found near these passes. They exist in abundance farther out upon the plain.

Another element necessary to bring about artesian conditions is such an adjustment of the sands and gravels through which the underground waters are percolating as to prevent their free escape at the lower edge of the plain. The increasing fineness of the materials, at greater distances from their origin, may have this effect. Their deposition against an earlier bed-rock mass may have this same result. But one of the most efficient forms of obstruction to the free escape of waters is an anticlinal fold in the gravels, transverse to the principal direction of percolation. Such a fold exists in the Coastal Plain. It is expressed topographically in the ridge which extends from Huntington Beach to the base of the Santa Monica Mountains, in the neighborhood of the Soldiers' Home. On the landward side of this ridge lies the largest artesian basin in Southern California, 192 square miles in area. Above the ridge groundwater levels are high, regular, and near the surface, and the supply is large; below the ridge groundwater levels are low, erratic, at a distance from the surface, and the supply is small.

Sources of Coastal Plain Waters.

Much of the greater part of the underground waters in the Coastal Plain is supplied by the flood waters of the three large streams which occasionally flow across it, the Los Angeles, San Gabriel, and the Santa Ana. Smaller amounts are supplied by local winter drainage from the hills surrounding the Plain, by the underflow of the large streams mentioned, by that part of the summer flow of these streams which returns to the ground waters after its use for irrigation, and by direct rainfall upon the Plain. The supply from all of these minor sources, combined, is probably much less than that from the flood waters alone. Observations upon wells show that during the summer season there is a general but not uniform lowering of the water plane, and that during the season of winter floods this is restored in whole or in part, the rise occurring first near the flood channels and spreading thence in a slow moving wave to more distant parts of the plain.

The supposition that there may be accretions from distant sources by underflow beneath intervening mountain ranges is entirely untenable. Continuous

underground channels through rock, such as this theory requires, exist only in regions where easily soluble rocks, limestones or dolomites exist in continuous masses. Percolation in quantity may also take place for long distances through porous sandstones, under favorable structural conditions, which are rarely encountered. Neither of these conditions exist in the hills and mountainous areas which separate the Coastal Plain from all distant sources of water.

It is seen by an inspection of this *table that there are about 8,000 wells in this region, that these wells and the pumping plants installed upon some of them represent an investment of about \$2,500,000; that nearly 2,500 of the wells are artesian and yield over 140 second feet of water continuous flow; that over 800 are equipped with pumping plants and that the output of these is more than 130 second feet, the total estimated output from these wells being about 275 second feet.

There are over 95,000 acres of land under irrigation. This includes the irrigation from surface systems and from sewage, as well as that from underground waters. About 5,600 acres are irrigated by use of the sewage below Los Angeles, and while no systematic attempt has been made to distinguish those lands which are irrigated by underground waters from those which utilize surface waters only, it is roughly estimated that 50,000 acres are dependent upon the former source.

The total irrigable acreage of the Coastal Plain is estimated to be about 400,000. Large as is the aggregate irrigation, it is thus seen to be but one-quarter of the territory which could be reclaimed if water were available for the purpose.

Decline of Coastal Plain Waters.

The last decade of dry years has seen a general contraction of artesian areas, a lessening yield of flowing wells and a corresponding lowering of ground-water levels, throughout Southern California. The Coastal Plain being the largest of the basins in which subterranean waters occur extensively and being supplied by the three largest streams of this part of the State, has not shown so alarming a shrinkage as some other areas, but even here the loss is heavy.

The original artesian area of 296 square miles has shrunken to 192 square miles. There is a general complaint of the lessened yield of wells, and water levels have fallen varying amounts, depending upon their situation relative to the sources of supply and to the artesian basin.

These phenomena are generally explained as due to drouth, but a careful examination of the evidence convinces the observer that they are not due entirely to this cause.

A continuous series of observations upon the fluctuations in the ground-water level has been maintained at Anaheim since February, 1894, by J. B. Neff (Exhibit 2). These are of great value for comparison with rainfall records, and when so compared throw much light upon the relative importance of development and drouth in bringing about the decline. March 1, 1894, the surface of the zone of saturation in these wells stood at 23 feet below the land surface. From this time, through the remainder of the dry period, lasting until the fall of 1900, the decline was continuous and very regular, averaging

*See table ("Development of Coastal Plain Waters") next page.

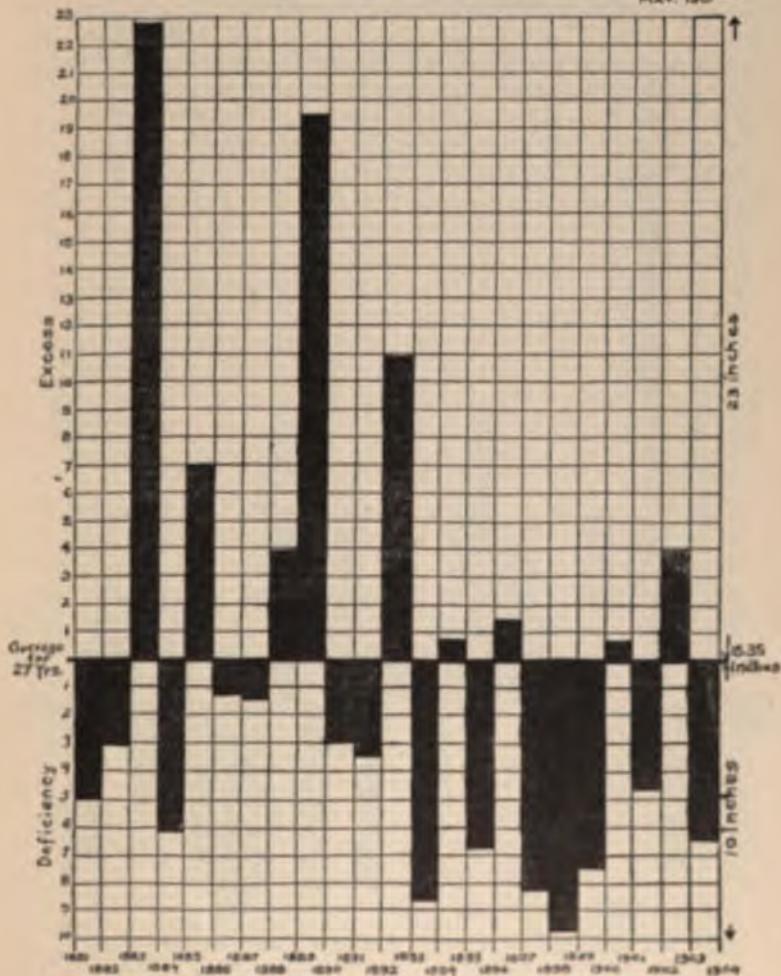
DEVELOPMENT OF COASTAL PLAIN WATERS

In the following table, the character, cost and yield of the wells installed, the number of acres irrigated, and the original and present artesian areas are given for each of the six quadrangles of the Coastal Plain.

Quadrangle	ARTESIAN WELLS		PUMPING PLANTS AND WELLS		DOMESTIC WELLS		TOTALS		ARTESIAN AREAS		
	Number	Cost	Number	Cost	Number	Cost	Wells	Cost	Acres irrigated	Original	Present
Anaheim	72	\$ 20,636	2,40	252 \$ 316,116	43,60	\$180,1098	1,422	\$ 516,064	46,00	28,833	36
Santa Ana	733	\$ 86,494	38,10	57	48,408	6,00	467	73,768	1,257	208,170	44,10
Downey.....	1339	\$85,500	84,80	172	235,892	44,10	1491	264,815	3,002	886,207	6,624
Las Boisas.....	296	16,000	15,00	2	.....	.....	6	1,000	304	17,000	42,071
Santa Monica.....	23	4,600	1,50	135	142,695	14,50	795	168,500	953	316,000	15,00
Redondo	12	1,200	.24	189	305,088	25,00	821	163,000	1,022	469,388	2,312
Totals	2475	\$514,430	142,04	807	\$1,048,199	133,20	4678	\$850,995	7960	\$2,413,829	275,24
										95,608	300,4
										190,7	

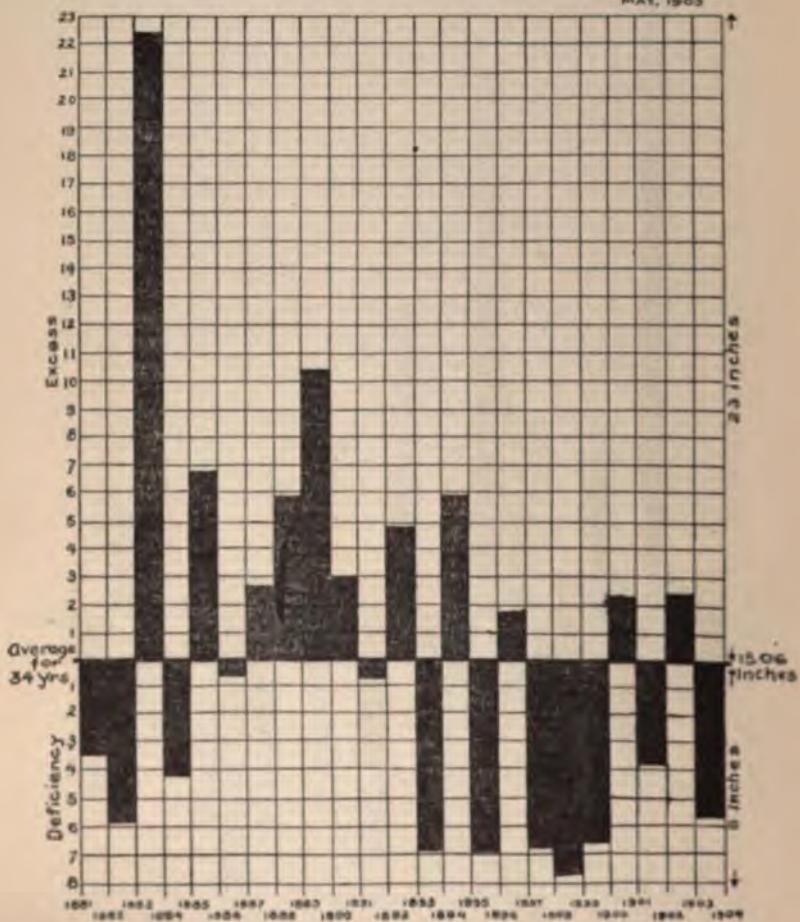
Los Angeles City Waterworks
Diagram
Showing Variation from Average Rainfall
at
Los Angeles, Cal.

LIPINSKI & MARSH
LAWRENCE, KANSAS
LOS ANGELES, CAL.
MAY, 1901

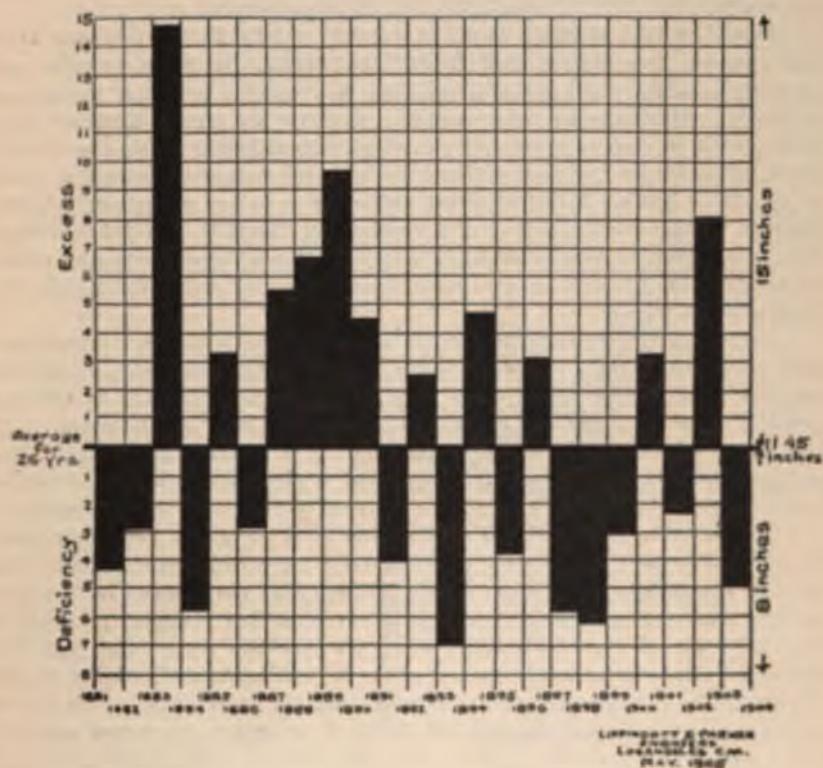


Los Angeles City waterworks
Diagram
Showing Variation from Average Rainfall
at
San Bernardino Cal.

LIPPINCOTT & PARKER
ENGINEERS
LOS ANGELES, CAL.
MAY, 1903



Los Angeles City Waterworks
Diagram
Showing Variation from Average Rainfall
at
Anaheim Cal.



between 6 and 7 inches per month. The moderately heavy rainfall of the succeeding winter raised the level 2 feet, but the gain was lost by the middle of the following summer, and the decline continued then at varying rates until the 1st of April, 1903. During this and the succeeding month, the water level rose $1\frac{1}{2}$ feet, but quickly fell about to the level which had ruled before the spring rains. This level was maintained until the first of January, 1904. After this date, the water lowered rapidly because of the dry winter of 1903-04, and the rapid increase in the number of pumping plants, until January 1, 1905, it stood at 51 feet below the surface, an average decline of over 4 feet per year since observations began. During the present winter there had been a recovery of 1 foot 2 inches from the lowest point by April 1st, the water on that date standing 49 feet 10 inches from the surface.

In order to determine the relative weights of excessive development and deficiency in rainfall, in bringing about this effect, charts are presented in which the excess and deficiency of rainfall for a period of years, at Los Angeles (Exhibit 8), San Bernardino (Exhibit 9), and Anaheim (Exhibit 10), are shown.

Since the Coastal Plain Basin is supplied chiefly by the drainage from Los Angeles, San Gabriel and Santa Ana Rivers, its water supplies are affected more by the rainfall within the San Gabriel and San Bernardino mountain ranges than by local rainfall. A composite record, compiled from local records in each of these valleys and at various points within the Coastal Plain, would furnish the most satisfactory basis for comparison with the profile of the water levels. All of Southern California is in one meteorological belt, however, so that when one part of it receives an excessive or a deficient rainfall, other parts are usually similarly affected. Hence these charts may safely be assumed to represent general conditions in the regions which supply the Coastal Plain waters.

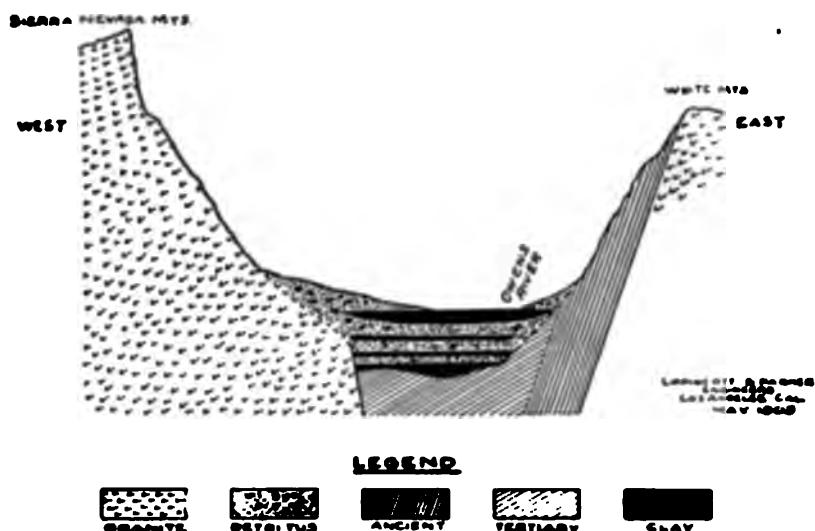
Obviously, the underground waters should not be withdrawn faster than they are restored. In a conservative use of the underground waters, as reserve supplies, they will be drawn down only during years of average or deficient rainfall, and will recover during years of excessive precipitation. If the water plane continues to decline during a year whose precipitation is above that of the average, it means that a permanent lowering is taking place, whose rate may be expected to increase with further developments.

The years during which the decline was sharpest in the Neff wells were, as we should expect, the years of greatest deficiency which preceded 1901. The rainfall that winter, which was over 2 inches above the average in San Bernardino and nearly 1 inch above the average in Los Angeles, produced a temporary rise in the profile representing the Anaheim water level, but that rise was lost and more before the end of the succeeding August, proving clearly that with the draughts at that time made upon the underground water bodies a rainfall above the average was not sufficient to restore the waters annually taken out.

Following the winter of excess in precipitation the decline was continuous, although not at a uniform rate, through the succeeding dry year, until early in 1903, when, in response to another year of increased rainfall, the water level rose about 1-1.2 feet, but this wave had passed and the water had fallen about to the level of the previous fall by August 1st. The winter of 1903-4 was again a winter of marked deficiency and in the region about

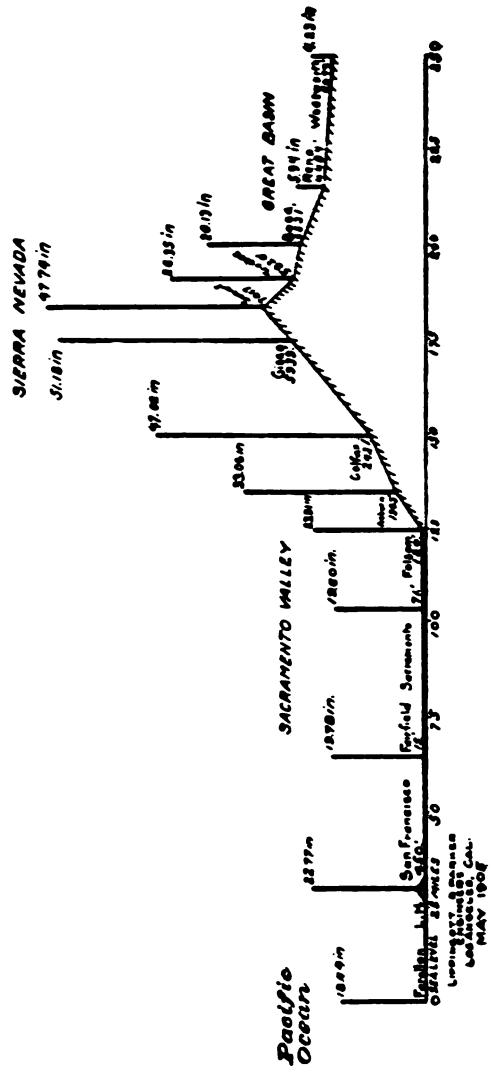
Los Angeles City Waterworks
Section
of the General Geological Formation
of
OWENS VALLEY

Vertical Scale 1" = 4000 feet
Horizontal " 1" = 4 miles.



Los Angeles City Water Works

Diagram showing unequal distribution of rainfall in California and Nevada, the result of topographic features.



Anaheim there has been a very rapid installation of pumps. In consequence, the water level declined during the spring of 1904 more rapidly than at any time since observations began, and by January 1, 1905, had reached the 51-foot level.

The conclusion seems inevitable, then, that in parts of the Coastal Plain, at least, where more water is being withdrawn by developments already made than is being returned during winters like those of 1900-01 and 1902-03, when the rainfall was 15 per cent or 20 per cent in excess of the average.

In a report upon the underground waters of the Coastal Plain by W. C. Mendenhall, Geologist, recently sent to the director of the U. S. Geological Survey, for publication as a water supply paper, the discussion of conditions in this great basin is closed with the following general summary:

(a) The underground supply is large, since it consists of the water saturating all of that part of the Coastal Plain gravels within pumping distance, say 250 feet from the surface, over an area of 600 or 700 square miles.

(b) The annual conditions to the supply are large, consisting of a part of the flood waters of the San Gabriel, the Los Angeles and the Santa Ana Rivers; of the return waters from irrigation on the Coastal Plain, of the relatively small underflow of the rivers named, and of local rainfall upon the Coastal Plain and the adjacent hills.

(c) The draughts upon these waters are large and, in parts of the area at least, are in excess of the supply at present.

(d) With present developments, the water plane is expected to continue slowly to decline, and the artesian area to shrink until drainage is checked by these shrinkages at a point where it no longer exceeds supply. It is believed that this decline will not prove serious except locally unless present developments are greatly increased.

(e) So long as water developments continue at a rate which increases the output, the shrinkage will continue.

(f) The lowering of the groundwater level and the shrinkage of artesian areas, even with continued development, will no doubt be interrupted by periods of rising water levels and expanding artesian areas, which will follow seasons of very excessive rainfall.

(g) The shrinkage of the artesian belt will be most manifest along its northern edge. The effect further south will be rather a decrease of flow and a lessening of pressure.

(h) Shallow artesian wells will generally be affected earlier and to a more marked extent than deeper ones.

Interdependence of Wells.

In general, each well in the Coastal Plain, above the Dominguez Ridge, whether flowing or pumped, affects every other well in the same region. Practically widely separated wells will not have a measurable effect upon one another, the actual effect being too small for observation. All drain from a common source, the body of saturated sands and gravels which underlie the wide plain between the Puente and the Dominguez Hills, and whatever reduces the amount of water in that body of alluvium affects all wells which draw from it.

The wells of the lowest ground are always most advantageously situated

when the source of water is common to all, and there is no impervious obstruction to interfere with free circulation.

These lower wells affect the higher ones more than they are affected by them, the mutual effect thus differing in degree.

In the artesian area, where the water, in its slow movement towards the sea, has passed below the strata of clay which are nearly impervious, strong flows may often be obtained from deeper horizons whose confining stratum extends further inland and whose pressure, therefore, originates at a higher point, after shallow wells have ceased to flow. The yield from such a deeper well will usually be less than if it had been drilled before the shallow well failed, because its pressure has also been affected by a general lowering of the water plane, hence a degree of interdependence exists even between those water horizons which are separated by clay lenses.

This fact of interdependence may seem that users of underground waters in the Coastal Plain region are rivals; it should also mean that they have a common interest in preventing waste and conserving their supplies.

Availability of Coastal Plain Waters for Los Angeles.

It must be constantly borne in mind that within this valley of Southern California the prosperity of any single community depends largely upon the prosperity of the surrounding communities. No city, no county, no enterprise stands alone in this regard. The City of Los Angeles will not build wisely for the future if it builds at the expense of any of the contiguous agricultural areas. With but one-fourth of the irrigable acreage of the Coastal Plain now under irrigation and abundant evidence available that the groundwaters, which furnish the greater portion of the supply used in this irrigation, are already being subjected to over draughts, it is evident that the City cannot permanently enter the field and subject the basin to further extensive draughts, which must continually increase as our City expands, without seriously interfering with the growth of one of our most promising agricultural regions.

Furthermore, in view of the trend of recent legal decisions, as expressed especially in the Katz-Walkinshaw case, it is a serious question as to whether the City could maintain title to these waters even were it to attempt to use them to supply its needs, without extensive condemnation proceedings. To gauge the seriousness of such a proceeding it should be borne in mind that \$2,400,000 has already been expended on pumping plants in this area for the irrigation of 95,600 acres. Many towns are also now dependent on this source. The possible charge for damage owing to extensive withdrawals by the City would be difficult to estimate, but doubtless would be very great.

Of the water which the City uses, a certain portion escapes through the outfall sewer and is carried to the sea south of Playa del Rey. This portion obviously is not returned to the drainage basin from which it is taken. Of that part of the water used by the City which is spread upon our lawns for purposes of irrigation, a limited portion returns to the underground circulation, but it is probable that the waters which thus return within the City limits escape in part by way of Ballona Creek to the ocean south of Santa Monica, and a part joins that other portion of the underground circulation of the Los Angeles River which tends southward. It is thus clear that but a minor part of the water eventually returns to this basin.

Under these conditions serious doubt exists as to whether the courts would sustain the City's rights to this Coastal Plain groundwater. It is entirely certain that expensive litigation would result as the City's wells drew the water away from the surrounding dependent agricultural lands.

The conditions which have been outlined may be summarized briefly thus:

First, the waters within the Coastal Plain are needed for irrigation upon it and do not suffice when developed to their utmost capacity for the irrigation of the lands there.

Second, convincing evidence exists that the draughts already made upon the waters are in excess of the supply in parts of the Coastal Plain.

Third, if the City were to install wells and withdraw the groundwaters, it would be at the expense of a portion of its tributary agricultural lands.

Fourth, there is a grave doubt as to whether the City could maintain title to these waters even were they developed, except at a great expense which cannot be even roughly estimated.

In view of all these conditions, it seems entirely inadvisable for the City to enter this field with the idea of developing an adequate supply to provide for its present needs and future growth.

LOWER SAN BERNARDINO VALLEY ABOVE RINCON.

The Santa Ana River is the most important stream of Southern California west of the Coast Range. It includes among its tributaries all of the streams entering the San Bernardino Valley, and drains a total area above Rincon of 1,463 square miles, including valley lands, but exclusive of the lands tributary to Lake Elsinore. There are 555 square miles of mountain area within the limits of the basin. San Bernardino Valley proper contains 523 square miles.

There is a secondary coast range lying along the western edge of the valley, through which the Santa Ana River cuts a canyon, beginning at Rincon and extending southwesterly about $5\frac{1}{2}$ miles. These hills are of a shale and sandstone formation of more recent geologic origin than the main range to the east, and constitute a dam or like which concentrates and throws to the surface most of the underflow or seepage water proceeding through the valley towards the sea. This produces a greater volume of water in the river at Rincon during the irrigation season than at any other place in California south of the Tehachapi Mountains, with the exception of the Colorado River.

The streams surrounding the San Bernardino Valley have drainage basins which are exceedingly steep and are poorly supplied with forest cover. The basin above Rincon is of granitic origin. The erosion of the mountains and the filling of the valleys has been of the same nature as in the case of the Los Angeles and San Gabriel Rivers. Consequently the floods of many past years which have been projected upon the plains are rapidly absorbed, and the great underground reservoir, with a controlling outlet at Rincon, has been filled.

If an area of gravel 500 square miles should be charged to a depth of 300 feet, its storage capacity would be 32,000,000 acre feet of water. These figures are given merely to suggest the capacity of this great underground storage reservoir of the San Bernardino Valley. It has been charged with waters through a long cycle of years by the floods described. In addition to the winter floods the summer flow of the streams from San Antonio Creek to Mill Creek is diverted and used for irrigation purposes, and possibly 33 per cent

of it sinks into the ground and re-enforces the water plane. The water surface of this large underground reservoir slopes toward Santa Ana River, and its surplus waters are brought to the surface in the canyon at Rincon. The velocity with which the water passes through the gravels is undoubtedly very slow and varies with the density of the soil and steepness of the slope, causing a very constant delivery of water at the Rincon Narrows.

It must be remembered that the available permanent output from this basin must be measured by the annual contribution thereto, and not by the volume stored therein. If the withdrawals exceed the inflow the storage basin will be depleted just as a man who spends both interest and principal will certainly gradually exhaust his capital. The volume passing through the Rincon Narrows represents that interest.

Applying the runoff per square mile as measured at the mouth of the Santa Ana Canyon to the total mountain watershed of the basin, we find the estimated discharge of the Santa Ana River from the mountain area tributary to the lower Narrows to be as follows:

Estimated Total Discharge from the Mountains of the Santa Ana Basin Above

Rincon.

	Runoff per Sq. Mile Second Feet	Estimated total discharge of 555 Sq. Miles Moun- tain Area, Second Feet
1897	.46	.255.3
1898	.21	.116.5
1899	.12	.66.6
1900	.16	.88.8
1901	.31	.172.0
1902	.19	.105.5
1903	.46	.255.3
1904	.22	.122.1
Mean	.266	.147.8

In the following table is given a series of measurements made by the U. S. Geological Survey approximately 1 mile below the railroad bridge crossing the Santa Ana River below Rincon, the measurements having been made at that point until September 29, 1899, since which date they have been made at the wagon bridge. On September 13, 1899, it was found that when there was 74.38 second feet of water at the Geological Survey gauging station there were 76.61 second feet of water at the wagon bridge, or 2.23 feet more water at the wagon bridge than at the Geological Survey station. The wagon bridge being the point of maximum flow, subsequent measurements were made there.

**Discharge Measurements of Santa Ana River and Canal Near Rincon, Below
the Mouth of Chino Creek.**

Date, 1898.	Hydrographer.	Discharge		Total Sec. Ft.
		of River. Sec. Ft.	Canal. Sec. Ft.	
June 21.....	F. H. Olmsted	79.81	3.18	82.99
Date, 1899.				
Jan. 3.....	S. G. Bennett	209.40	2.30	211.70
" 16.....	F. Rolfe	231.90	0.00	231.90
" 26.....	"	216.00	6.50	222.50
Feb. 15.....	"	181.00	1.75	182.75
Mar. 4.....	"	108.60	0.00	108.60
" 18.....	"	199.89	0.00	199.89
April 6.....	"	172.23	0.00	172.23
" 18.....	"	101.10	2.75	103.85
May 2.....	"	100.34	2.45	102.79
" 15.....	"	100.36	3.95	104.31
June 3.....	"	110.27	3.18	113.45
" 16.....	S. G. Bennett	87.99	1.63	89.54
July 4.....	F. Rolfe	68.69	2.42	71.81
" 18.....	"	64.13	1.54	65.67
Aug. 1.....	"	57.82	3.44	61.26
" 15.....	"	64.71	3.16	67.87
" 30.....	S. G. Bennett	65.90	2.00	67.90
Sept. 13.....	J. B. Lippincott	72.73	1.65	74.38
" 29.....	F. Rolfe	83.82	0.00	83.82

Discharge Measurements of Santa Ana River at Wagon Bridge Above Mouth
of Chino Creek.

Date,	Hydrographer.	River.	Chino Creek.	Springs.	Total Dis-
		Sec. Ft.	Sec. Ft.	Sec. Ft.	Sec. Ft.
Oct. 26.....	J. B. Lippincott.....	131.32	14.52	0.50	146.34
" 26.....	"	146.53	14.52	0.50	161.55
Date, 1900.					
April 17.....	W. P. Searcy.....	101.60	8.79		110.39
June 24.....	"	69.20	3.97		73.17
July 7.....	"	84.47	2.09		86.56
" 28.....	S. G. Bennett	60.76	2.20		62.96
Aug. 15.....	W. P. Searcy.....	87.10	1.08		88.18
Sept. 3.....	"	88.80	0.00		88.80
Oct. 5.....	W. W. Cockins, Jr..	74.20	5.00		79.20
Date, 1901.					
Aug. 27.....	J. B. Lippincott....	78.60			
" 31.....	"	65.30	2.80		68.10
Date, 1902.					
Sept. 2.....	W. B. Clapp	74.90			
Date, 1903.					
Mar. 31.....	"	400.00	146.00		546.00
April 29.....	O. W. Peterson ...	193.00	23.00		216.00
May 18.....	W. B. Clapp.....	108.00	15.00		123.00
June 12.....	"	85.00	6.50		91.50
July 28.....	"	59.00	3.40		62.40
Aug. 19.....	"	60.00	2.40		62.40
" 23.....	"	78.00	3.30		81.30
" 30.....	"	93.00	6.00		99.00
" 25.....	"	102.00	9.20		111.20

The Santa Ana and Anaheim Water Companies have purchased large areas of lands in the gravel beds where the waters of the lower Santa Ana rise, both to protect themselves against encroachment and to permit of development for their own use. They have also vigorously opposed any trespass on what they consider their rights on the part of others along the stream.

The entire flow of the Santa Ana River at the Lower Narrows is controlled by Fullerton, Orange and Santa Ana Water Companies, is completely diverted and used during the summer months to irrigate the rich farm lands south of Rincon. The area of this irrigated territory is 30,391 acres.

A water supply sufficient for future needs of the City of Los Angeles could be obtained from the Santa Ana at Rincon by the condemnation of the lower rights of the river, but the destruction of town property, and extensively developed farming of this region, would not only be a heavy loss to Southern California in general, but would have a depressing effect upon the trade of Los Angeles and the future growth and development of the City. (It would be impossible to recommend this.)

The value of the improved land dependent upon water from the lower Santa Ana is about \$500 per acre. The cost of condemning this territory of 30,400 acres at \$500 per acre is \$15,200,000, to which must be added legal fees, possibly amounting to \$250,000.

The approximate length of a cement gravity conduit required to bring the water from the Narrows to Los Angeles is 62.7 miles, of which 5.1 miles would be tunnel and 2.7 miles steel pressure pipe. The lift necessary to command the reservoirs of the city is 218 feet. No detailed estimate of the cost of this conduit line and pumping plant has been made, but it is believed the total cost would be about \$3,500,000.

TRIUMFO AND MALIBU.

A small supplemental supply of water for the district lying between Hollywood and Santa Monica from reservoirs designed to impound the flood waters of the Triumfo and Malibu Creeks may be considered with propriety.

The Triumfo Creek has its origin in the Santa Monica Mountains at an elevation of about 3,000 feet. The Malibu Creek is formed by the junction of the Triumfo and Las Virgenes Creeks and discharges its waters into the Pacific Ocean about 12 miles west of Santa Monica. The mountain area of the Triumfo is mostly of a shale and sandstone formation unoccupied except for stock farming, and is covered with a thick brush, some live oaks and cottonwood. In 1904 a reservoir of 5,200 acre feet capacity was built which commands 15.6 square miles of the upper portion of this water shed.

The watershed of the Malibu has the same rock formation, but is sparsely covered with trees and brush, and perhaps one-half of its area is farmed. No observations of the rainfall have been made, but from comparisons of the rainfall of similar locations, the average is believed to be about 18 $\frac{1}{4}$ inches per annum. In 1901, the Geological Survey established gauging stations on both the Triumfo Creek and Malibu Creek. The one on the Triumfo is located about one-half mile above the junction of the Las Virgenes and Triumfo Creeks and has a drainage area of 72 square miles. The one on the Malibu is situated

south one fourth of a mile below the junction of the Triunfo and Los Villegas Creeks and has a drainage area, exclusive of the Triunfo watershed, of 35 square miles, or a total drainage area including the Triunfo of 97 square miles. The discharge measurements as recorded at three gauging stations are here given.

DISCHARGE MEASUREMENTS OF TRIUNFO CREEK.

Year	Month	Acre ft.	Year	Month	Acre ft.
1903	January	283	1904	January	154
	February	644		February	178
	March	1491		March	295
	April	2574		April	104
	May	461		May	37
	June	366		June	dry
	July	123		July	dry
	November	36		August	dry
	December	123		September	dry
		---		October	dry
	Total for the year 1903	7059		November	dry
	Or 9.75 second feet.			December	dry

				Total for the year 1904	798
				Or 1.10 second feet.	

DISCHARGE MEASUREMENTS OF MALIBU CREEK.

Year	Month	Acre ft.	Year	Month	Acre ft.
1903	January	523	1904	January	307
	February	872		February	316
	March	2928		March	424
	April	7188		April	179
	May	578		May	135
	June	327		June	89
	July	160		July	...
	November	119		August	...
	December	252		September	...
		---		October	61
	Total for the year 1903	12,847		November	71
	Or 17.74 second feet.			December	301

				Total for the year 1904	1883
				Or 2.60 second feet.	

The measurements for 1905 are not available now, but they are known to have been larger than either of the years given. Both the Triunfo and Malibu are torrential streams discharging relatively large volumes of flood water during the winter rains. These flood waters have no value unless impounded by storage reservoirs so as to properly regulate the flow as required by either domestic or irrigation purposes as they discharge into the sea. Very little use of the water of these streams has as yet been made. The Malibu

Creek passes through the property owned by Fred K. Rindge, who owns a large ranch along the ocean front and who may claim riparian rights to this creek.

Although the water is not high grade chemically, there is little organic contamination. The quality probably resembles the water used by the City of Santa Barbara. They should be analyzed before any extensive expenditure is incurred for their utilization.

Apparently good reservoir and dam sites exist on both the Triumfo and Malibu Creeks. The best dam site on the Triumfo Creek is located about one-half mile above its junction with Las Virgenes Creek, and commands the same drainage area as the watershed above the geological survey gauging station. The dam site on the Malibu Creek is below the junction of Triumfo and Malibu Creeks and has a slightly greater drainage area than is commanded by the geological survey gauging station on the Malibu.

From the discharge measurements as given on page 64, the total discharge of the Triumfo Creek for the year 1903 was 7059 acre feet or 9.75 second feet continuous flow for one year, one second foot flowing for one year being equivalent to 724 acre feet. In 1904 the discharge was 798 acre feet or 1.10 second feet. The mean discharge is 3928 acre feet or 5.43 second feet, which was the average amount available for storage on the Triumfo for the years 1903 and 1904. According to the measurements on page 64, the discharge of Malibu Creek available for storage purposes at the lower reservoir site, was 12,847 acre feet, or 17.74 second feet for the year 1903. Subtracting the discharge of the Triumfo, as measured for that year, namely 7,059 acre feet, or 9.75 second feet, the amount available for storage at the Malibu Reservoir site is found to be 5,788 acre feet or 8.00 second feet. Similarly the discharge of the Malibu for the year 1904, exclusive of the run-off from the Triumfo, is found to be 1045 acre feet or 1.50 second feet. The mean discharge of the years 1903 and 1904 is 3436 acre feet or 4.75 second feet. The discharge for the year 1903 is probably somewhat above the mean. The discharge for 1904 may be taken as a minimum. As the measurements have only been taken for the past two years of less than average rainfall, an exact determination of the amount available for storage on mean and wet years is impossible, but it is believed the average yearly discharge from the Triumfo watershed is 7,000 acre feet and from the Malibu drainage area, 3,000 acre feet or a total annual supply available for storage at the two reservoir sites of 10,000 acre feet, or 13.8 second feet continuous flow. This is equivalent to 27.6 second feet during six months of the year. In order to rely on average annual discharge of 10,000 acre feet, it would be necessary to construct dams of sufficient height to impound a three years' supply so as to hold over from years of plenty to years of drouth.

A dam on the Triumfo 100 feet high would be about 20 feet long at the base and 150 feet long on top and would have an approximate capacity of 21,000 acre feet, sufficient for a three year supply with an annual output of 7,000 acre feet. The capacity of the reservoir is taken from a small scale topographic map, and is not exact. A rock fill dam 20 feet wide on top with a slope of $1\frac{1}{2}$ horizontal to one vertical on the upper face and $1\frac{1}{2}$ to one on the lower face, is made the basis of estimate. Provision is made for a dry laid wall two feet thick on the upper face upon which an asphalt concrete apron one and one-half feet thick would be laid. At the base of the apron a cut-

... we have 100 000 to cover expenses.

The total amount available now is \$1,000,000.00 which will be
repaid at a fixed rate over five years. The interest is 6% per annum. The
amount of the investment has been set at \$1,000,000.00. The following is a summary
of the total amount available for the first year: \$1,000,000.

The final confirmation of the ownership and the ownership of the title
will take place before the available title transfer date from the transfer
of ownership or when the title is registered at the appropriate jurisdiction
where the title is registered.

Since general glaze availability etc. is a limited factor we would recommend that the diameter be limited to 10 feet and total height 10 feet. We would like to have diameter increased to 12 feet and height increased to 12 feet. This would increase the volume of the tank by 20 percent over the present design. The cost of the tank would be approximately \$10,000.00.

Take such opportunity there be apprehended for intercepting & removing
Banks droppings; but a still greater if skillful investigation and service. I may
mention what others and I still can never be satisfied which constitutes the City of
last creation.

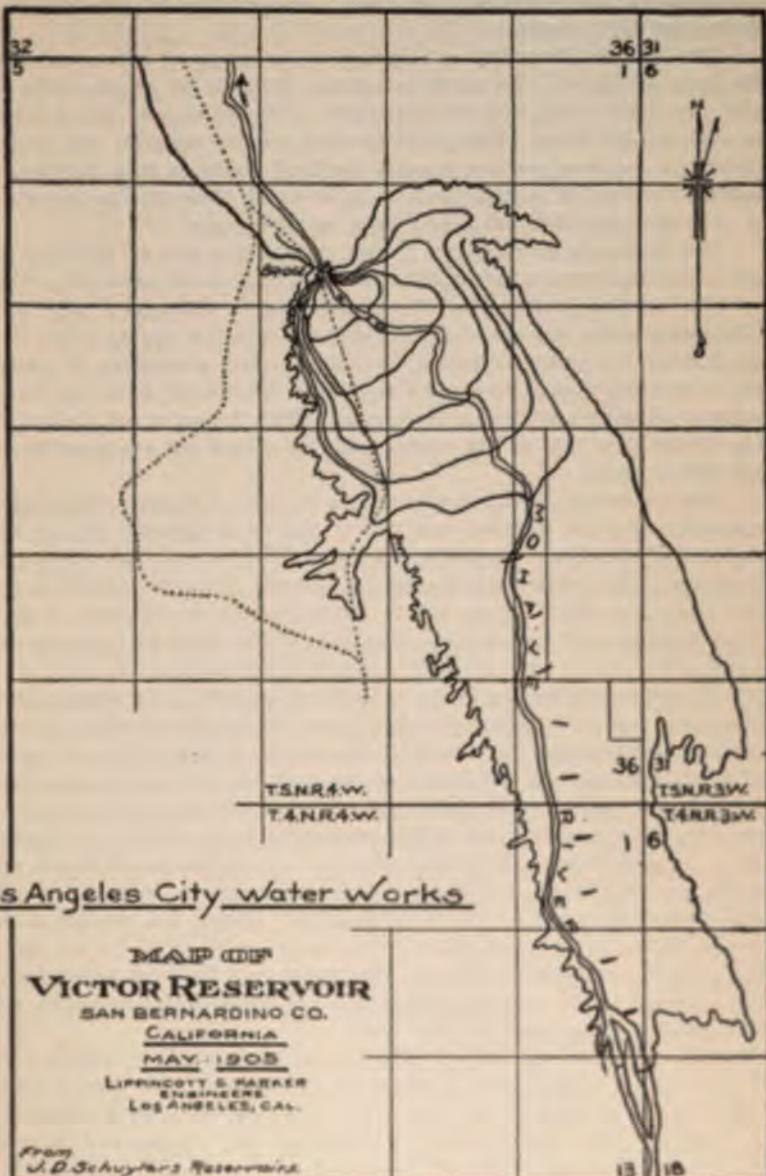
The cost of returning 500 shares above is minimum now from the
Bank of America which would be approximately \$1,500,000 or \$3,000 per share
and the cost per 500 shares would be about 1/3 less than the minimum specified
and consideration could easily be obtained.

NOTA VILLETTA

The Mohave River flows on the northwesterly slope of the Sierra Madre mountains in San Bernardino County, its headwaters being about 60 miles northeast of Los Angeles. The course of the main stream is semi-circular and runs generally west, south east, and as is common in arid regions, decreasing in elevation as it penetrates through the plains, until the surface water disappears in a series of short distance below Barstow.

The precipitation falling in form the Mohave rise at elevations between 6,000 and 6,500 feet will flow as potential water through the mountain washes to about elevation 3,500, where the summer flow is first absorbed by the sand and gravel deposits of the desert wash. This is about $1\frac{1}{2}$ miles below the junction of the east and west forks of the river. A permanent stream again appears starting from the gravels about seven miles above the Victor cut-offs and flows with increasing volume to that point.

To the west of Victor, there are many mountains that drain towards the Malheur River, but their streams, which are small and few in number disappear



as soon as they reach the sands of the desert. The general slope of the great valley is towards the Mohave River from the west at the rate of two feet to the mile, but the rainfall is so light (about 3 inches per annum) and the summer heat and evaporation so great, that there is no contribution to the river from that source.

The Mohave River has cut through a low range of hills a mile south of the town of Victor. The gorge is narrow, with abrupt granite cliffs on each side. A contour 145 feet above the bed of the stream at this point is said to enclose 7,500 acres. This is the greatest natural reservoir site in Southern California and is in position to catch the flood discharge from the basin to the south. No exact survey of the basin is at hand. The data as to its capacity is obtained from Mr. Schuyler's book on Reservoirs.

The Santa Fe railroad now passes through the site of the dam and reservoir and that portion, about 5½ miles in length, would have to be rebuilt.

The watershed above the Victor Dam site is 435 square miles of which 252 square miles are mountainous. Of this area 86 square miles, or about one fifth of the entire watershed, the portion most productive of stream runoff, is included in the drainage area of the Arrowhead Reservoir Company's system, which is now being constructed. This leaves a net drainage above the Victor Dam site of 349 square miles of which 166 are mountainous and 183 desert plains.

The watershed is well covered with a growth of timber at the crest of the mountains, but the number and size of the trees diminish as the desert is approached, the lower portion of the basin being covered with desert vegetation only. This condition is due to the decrease in the precipitation, the rainfall being very slight on the desert, but increasing as the crest of the mountains is approached, culminating at the summit in about 60 inches of rain and snow.

In the mountains the precipitation is frequently heavy, often falling on slopes that are both rugged and steep, thus yielding floods which, pouring out of the hills, flow into the desert far beyond the ordinary limit of the stream, filling the porous sand and gravel of the river beds as they progress, and disappearing as rapidly as they come. From twenty-four hours to a week later, the bed of the stream at the surface will again be found dry. A large portion of the precipitation in the higher elevations is snow, a material part of which is lost by evaporation, and the remainder augments the stream flow. This is the general character of the Mohave River. During the summer it flows in places where the general position of the canyon walls or of the bed rock forces the ground water to the surface in streams of from 20 to 30 second feet, rising and sinking on its uncertain journey as it encounters impervious material, and finally losing itself in the desert.

*Measurements made by F. W. Skinner, civil engineer, between January 1, and August 1, 1893, gave a maximum discharge of 4,500 second feet and a minimum of 35 second feet, from which the mean flow from August 1, 1892, to August 1, 1893, was computed as 825 second feet. This would be equivalent to an annual runoff of 507,360 acre feet.

At the same time it was noted by the appearance of the drift along the banks and the statements of the residents of Victor, that the highest floods of

*Schuyler's "Reservoirs for Irrigation," page 376.

that season lacked several feet of reaching the high water marks of previous years. The rainfall at Los Angeles for the season of 1892-93 was 26.27 inches.

In order to determine the amount of water available for storage in the Mohave, the U. S. Geological Survey established a gauging station at Victor in 1899. The following table is a record of the discharge of the Mohave at Victorville.

ESTIMATED DISCHARGE OF THE MOJAVE RIVER AT VICTORVILLE.

	Total discharge	Half discharge
	Acre feet.	Acre feet
1899	17,428*	
1900	32,204	16,102
1901	103,820	51,910
1902	36,756	18,378
1903	107,842	53,921
1904	34,121	17,060
1905	59,000**	--
Mean for five years 1900-04 inclusive.		
	62,948 Acre feet.	31,474 Acre feet.
	56.94 second feet	33.47 second feet

The bed of the Mohave River at the gauging station is of a shifting sandy nature and the section cannot be permanently rated. A gauge rod has been placed at the station, and the height of the water thereon is noted daily. An observer who lives at Victorville is employed to measure the water at frequent intervals of time, and especially whenever there is a change in river levels due to flood conditions. While the record is not perfect it is believed to be a fair approximation of the truth and certainly the best available data. Estimates based upon precipitation in the basin, a very large portion of which is snow which is attacked by the dry desert winds, are not believed to be as reliable.

LOS ANGELES RAINFALL

1899	11.30
1900	8.69
1901	11.96
1902	13.12
1903	14.77
1904	11.88
1905	19.35

*Discharge from March 1st, to December 13th.

**Discharge from January 1st to April 1st.

Evaporation Record for South Foothills of Mohave Valley.

1898.	Inches.	
January	2.95	Estimated.
February	3.25	"
March	6.50	"
April	8.00	"
May	9.45	"
June	10.70	Observed.
July	11.20	"
August	10.00	"
September	11.80	"
October	6.50	"
November	3.25	"
December	2.95	"
	—	"
Year	86.55	"

Such a loss by evaporation from a water surface is a very serious matter when it is proposed to hold over water for a term of wet years to provide for years of deficient stream flow. It is one of the reasons for being conservative concerning the water supply available from this source.

In view of these records the available supply from this source cannot safely be considered as over 40 second feet.

The measurements made during the last five years of light rainfall may be accepted as a minimum which unfortunately controls the amount that may be relied upon from this source.

The amount of water available at the Victor Reservoir for storage purposes, should the Arrowhead diversion of one-third of the highest watershed be made, will probably be not over one-half of the total discharge. One-half of the mean discharge for the years 1900 to 1904 inclusive, of 31,474 acre feet or 43.47 second feet, is taken as the reliable amount that could be secured from this source, provided the diversion works of the Arrowhead Company now under construction are built.

A record of the amount of evaporation from an exposed surface in the foothills of the Mohave Valley west of Victor has been obtained. The observer was an engineer and he employed standard methods of measurements during eight months including the summer of 1898. The remaining four months of the year from January to April inclusive, have been estimated. The observer requested that the locality should not be named, owing to the possible effect of the record upon certain enterprises under contemplation.

As it is estimated that the City of Los Angeles will require 47.7 second feet more water in the year 1925, for this municipality alone, than is now available from the Los Angeles River, this supply will hardly meet the requirements of the case, especially in view of the heavy expense involved in obtaining it. The 47.7 second feet noted above is on the basis of the total supply continuing from the Los Angeles River. There are other high grade lands upon which any water obtained by storage in the Victor reservoir may be put.

Besides the water claimed by the Arrowhead Reservoir Company, the

runoff from 86 square miles of the upper mountain watershed of the Mohave, the normal flow of the river below Victorville is used for irrigation purposes. A large dairy ranch is also irrigated in the reservoir basin, above the river gauging station of Victor. On the Mohave near Daggett, 45 miles northeast from the Victor Narrows a submerged dam has been partly constructed to divert the subsurface stream into irrigation canals for the Southern California Improvement Company. With the exception of the Arrowhead Reservoir Company, the adverse rights to the waters of the Mohave River are not extensive and could probably be condemned if a serious effort were to be made to do so by the City of Los Angeles.

As the mountain watershed of the Mohave is an unoccupied forest reserve and the desert plains, excepting at the town of Hesperia, have few inhabitants the water of this river above Victorville is practically exempt from danger of contamination. The mountain area being granitic in character, the mineral compounds occurring in the water would be relatively small, indicating an excellent water for both domestic and irrigation purposes.

In view of the results shown by the stream measurements of the last five years, giving a total mean yearly discharge of 62,948 acre feet, of which 50 per cent may not be available without the purchase of the Arrowhead Reservoir Company's system, together with available evaporation records, it is not deemed advisable to consider a dam which will impound more than 100,000 acre feet, or sufficient to hold a three years discharge.

The dam site is 140 feet wide at the bed of the stream with walls of such slope that the width is but 360 feet at an elevation of 130 feet above the stream. Figure on page 72 shows the diamond core borings made by the United States Geological Survey. The maximum depth to bedrock was found to be 46 feet. Photograph (upper cut, insert page 75) shows the dam site, looking upstream.

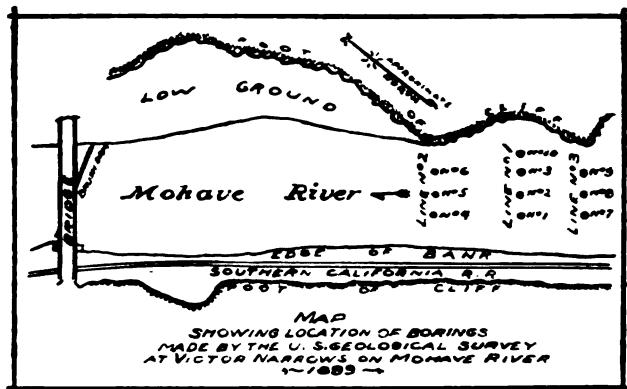
The small map of the reservoir site is taken from Schuyler on "Reservoirs for Irrigation", page 379. The outline of the drainage basin is shown on the General Map, Exhibit on Page 67.

Though the surveys of the reservoir site are meager, it is believed its capacity, with a dam 120 feet above bedrock or for a maximum depth of 66 feet of water, would be in excess of 100,000 acre feet. A masonry dam 120 feet high would be about 230 feet long on top and cost approximately \$500,000.

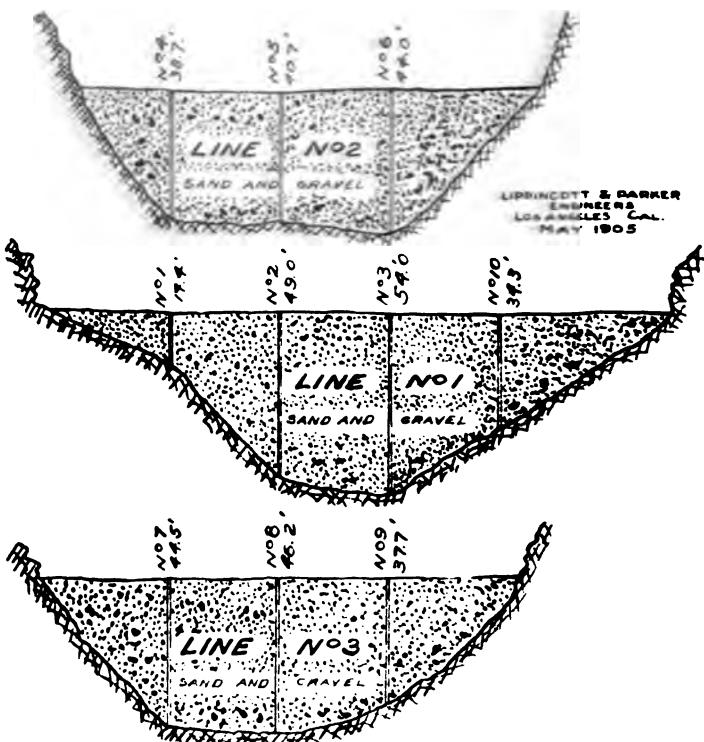
The underflow at the dam site was measured by Professor Charles S. Slichter for the United States Geological Survey. He states as follows: "At this point the river passes through a narrow gorge, barely 120 feet wide at the river surface. Here the greatest depth to bed rock is 46 feet, and the material is a very coarse granite sand or fine gravel. A double row of test wells across the Narrows, with extra down stream wells for the determination of the direction of flow, gave velocities at various points of 6, 8, 20, 33, 48 and 64 feet per day. Notwithstanding these high rates the total volume of underflow is quite small on account of the limited cross section (4,160 square feet). Estimating a porosity of 33 per cent and an average velocity of 50 feet per day gives a total underflow of 0.8 second feet, or 520,000 gallons per twenty-four hours."

"The velocities at this point were so high that the electrolyte passed between wells only 18 inches apart without touching them, and a small quan-

Los Angeles City Waterworks



Cross Sections on line of Borings



tity of caustic potash had to be added to spread the electrolyte into a broad stream."

The approximate elevation of the water level at the Victor Reservoir would be 2785 feet. To convey the water across the mountain range to the south into the San Bernardino Valley, pumping would be required to lift the water to a probable elevation of 3185 feet where it would be delivered to a gravity conduit, which could connect with tunnels driven through the summit of the range. Numerous adjustments can be made between the amount of lift and the length of tunnels. In this estimate the total lift would be 400 feet and the length of tunnels approximately 8 miles, the main tunnel being about five and one-half miles long. A pressure pipe from the southerly portal of the main tunnel could deliver the water under a head of nearly 1400 feet to a hydro-electric power plant, situated on the south side of the mountains at an elevation of about 1750 feet. This would furnish enough power to lift the water the 400 feet on the north side of the mountain to the tunnel level.

From this power plant a conduit would follow the southerly base of the Sierra Madre mountains to a point north of Pomona, where a pressure pipe could deliver the water under a head of 500 feet to a second power plant at an elevation of about 1200 feet. A third power plant near the mouth of the San Gabriel Canyon is a possibility in this line, but its desirability cannot be stated, without more complete data. Should the conduit from power plant No. 2 at Pomona be used only as a gravity line to Los Angeles, it would deliver the water at an elevation sufficient to command the entire distribution system of the City.

The total length of the gravity conduit is estimated to be about 85 miles in addition to approximately 10 miles of tunnel and 9 miles of pressure pipe.

These estimates of distances and elevations are not based on special field surveys and are to be considered only as approximate. They are taken from the topographical maps of the United States Geological Survey.

The Arrowhead Reservoir Company is now constructing a series of reservoirs on the headwaters of the Mohave River, the intention being to divert this water into the easterly end of the San Bernardino Valley. It is reported that suits are now pending on the part of lower riparian owners to enjoin this diversion. If the company succeeds in diverting the water, it will be available for immediate use in the neighborhood of Highlands, San Bernardino and Rialto. This district is capable of as high a horticultural development as any section of the state. There are many thousands of acres of arid lands in that neighborhood which require the water.

The development of the Highlands section will be of great value to the commercial interests of the City of Los Angeles. In addition the seepage and return waters from the irrigation of these bench lands will be of value in sustaining the underground water supplies that are requisite to the maintenance of Riverside and that vicinity. Extensive opportunities for the development of water power increases the value of this water to the company. It is believed that this water will be worth to the irrigators in the neighborhood of Highlands and San Bernardino approximately \$1500 a miner's inch of continuous flow. Any interference with the development that would result from the application of this water for irrigation purposes is a matter which should be very seriously considered by the city.

This is one of the most promising developments along sound engineering lines in Southern California, and it should be encouraged. It should not be interfered with except in an extremity.

The length of conduit from these reservoirs to the City of Los Angeles would be in the neighborhood of seventy miles. It is not believed that the supply would be adequate to meet the requirements of the City of Los Angeles and suburban towns that are now well in sight.

KERN RIVER.

A preliminary report on the feasibility of obtaining a water supply from Kern River has been prepared by Mr. Frank Olmstead, civil engineer. This has been presented to the board and has been carefully considered by it in connection with other projects.

On Kern River there are today two expensive power plants that have been constructed, and two others under construction. In addition, all the ordinary flow of Kern River is used for the irrigation of lands in San Joaquin Valley near Bakersfield. A great reservoir site exists on the Lower Kern River at a place known as Buena Vista Lake. This is owned by the Miller & Lux Company, and into it all surplus flood waters of the Kern River are discharged for further irrigation use during the low stages of the stream. In addition, the distance from Kern River to the City of Los Angeles is very great.

It will be seen, therefore, that very grave difficulties in addition to the cost of construction exist which would have to be overcome in connection with obtaining a water supply from this source. The population of Kern County in 1900 was 16,480 and this is some measure of the interests involved by the removal of this water supply. The area irrigated was 112,533 acres in 1900.

Mr. Olmsted's report is as follows:

ON THE PROPOSITION OF DIVERTING KERN RIVER WATER TO LOS ANGELES.

The mean flow of Kern River is 550 cu. ft. per second, frequently dropping to 200 cu. ft. per sec. in September or October for the mean monthly flow.

The total land valuation of Kern County is approximately forty million dollars and the Kern River is the only stream of any importance that makes this land valuable, the development of the Delta even now being retarded by lack of water.

Bitter litigation would result from any attempt to take the lower Kern River flow and probably so from any attempt to extract and carry away water from anywhere in the shed.

The South fork of Kern River is relatively an unimportant factor in the water supply for the Kern River Delta.

By damming the Menache Meadows, a large natural reservoir on the South Fork of Kern River at an elevation of 5,270 feet, an amount of water could be stored that probably at present does as little good to anyone as any unappropriated stream on the Coast.

From this reservoir, I believe there could be in the neighborhood of 4,000



SOUTH FORK, ABOVE MEBACHE DAM SITE (*See page 520*)



SOUTH FORK DAM SITE (*See page 521*)

inches constant flow delivered by gravity through Walker Pass and enough left to more than make good the present supply to the irrigators in the South Fork Valley.

The result of this would be that the main flow of Kern River would be depleted by the quite uniform surface flow of the South Fork into the main stream of 20 cubic feet per second and whatever flood waters rush past this junction, generally discharging into Buena Vista Lake. There are 170,000 acres under the Delta ditches and with the pumping plants, there is ordinarily enough water for the irrigation of 150,000 acres. The Delta canals and ditches have cost about \$5,000,000.

The Menache Reservoir is at the lower end of a catchment basin having an area of 140 square miles, with an average elevation of 9,000 feet above the sea.

No good data exists as to the amount of snow and rainfall over this area.

In the season of 1903-4, when Los Angeles had a precipitation of 8.72 inches and Kernville of 5.15 inches, the two gauges in the Menache Meadows read 16 inches and 11 inches respectively. This was the first attempt ever made to gauge the snow (in terms of rainfall inches) in the Menache, and would indicate to me that over the balance of the shed, where the precipitation naturally would be greater, there would not be less on the average than 30 inches for the whole basin above the Menache. In this case at least 9 inches would reach the reservoir.

This nine inches would mean, after deducting 36 inches over the extent of the reservoir (4000 acres) for evaporation 102 cubic feet per second constant flow. Allowing 22 feet to pass on down to the irrigators as it suited them best to receive it, would leave 4,000 inches for Los Angeles.

In reviewing all the measurements that have ever been made, of which I am conscious on Kern River, there is nothing to corroborate, and I may say, nothing to discredit the above statement. This is so because there has never been any attempt to measure the flood flow of the South Fork of Kern River.

Should the City be interested in this matter, an outfit should be dispatched at once to measure the floods which will commence this month.

The statement that the Menache would supply this 4,000 miners inches constant flow is certainly much less of an assumption than that Kern County under any condition would allow Los Angeles to take a drop of it in a conduit through Walker's Pass.

The engineering difficulties of carrying the water from the Menache to Los Angeles are not great save the very size of the undertaking.

The dam site for an 80-foot dam is admirable—bedrock is not over 15 feet deep at any point in the cross-section—and this dam would not be over 400 feet long on top with natural rock buttresses on either side. The dam would be rockfill and sheathed or faced with a steel-concrete skin 14 inches in thickness.

The conduit for the first 20 miles would be the natural rock channel of the stream.

From this point to Walker's Pass, a distance of 24 miles, the conduit would naturally be a concrete lined gravity canal on a comparatively rapid grade, say a cross-section 7 feet wide, 3 feet deep and with a velocity approaching 5 feet a second.

At Walker's Pass to Coyote Holes, where there would be a great drop, there

could be developed electric power which could be transmitted to the head of the Soldered to raise the water from the desert depression over this divide. From Coyote Hole to Red Rock Canyon and then on to the pumps near the Soldered Divide the conduit should be buried under the sands and could be a steel concrete box with oval top. From the pumps on over the Divide the water would be carried in a number of cast iron mains, say 30-inch diameter. From the Soldered Summit on, the gravity line could best be a cement lined conduit that would easily discharge its contents into the Pacoima, with a long drop of possibly 300 feet. The Soldered section would be hard to maintain, and it is probable that a tunnel through the Mt. Gleason Range might provide a better location than a surface grade around the point of the hills into the Pacoima.

From an engineering standpoint there could be nothing much better hoped for in a California concession over a mountain country than this line.

From the lower Kern River near Bakersfield water could be brought into Los Angeles, but it would entail a heavy pumping expense in lifting it over the Sierra Madre, as well as magnifying the legal difficulties before referred to, that I have not outlined elsewhere.

In considering Kern River as a reinforcement for the Los Angeles water supply, the point of more importance is, can the right be reasonably obtained or retained?

An artificial well in South Park above the 4000 foot contour furnish water enough to make it a possibility.

Having secured sufficient water, there would be no need to look further in the matter.

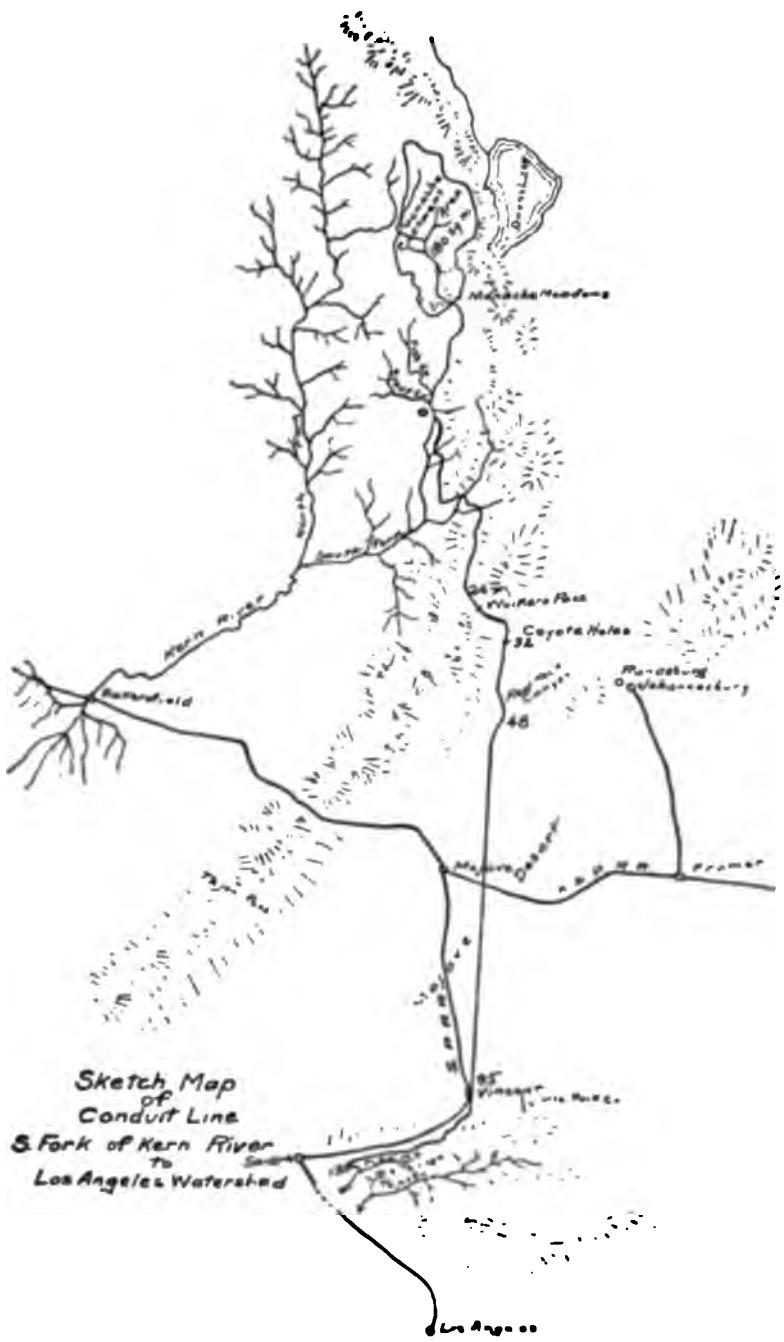
From my observations occurring these years in close touch with the interminable legalities and legal battles involved for a Los Angeles corporation to acquire the right to merely take Kern River water out at one point into a canal and discharge it lower down into the original channel, I hesitatingly agree that the price impossibly high the right could ever be obtained, even of something like \$30,000,000 were it finally to be had.

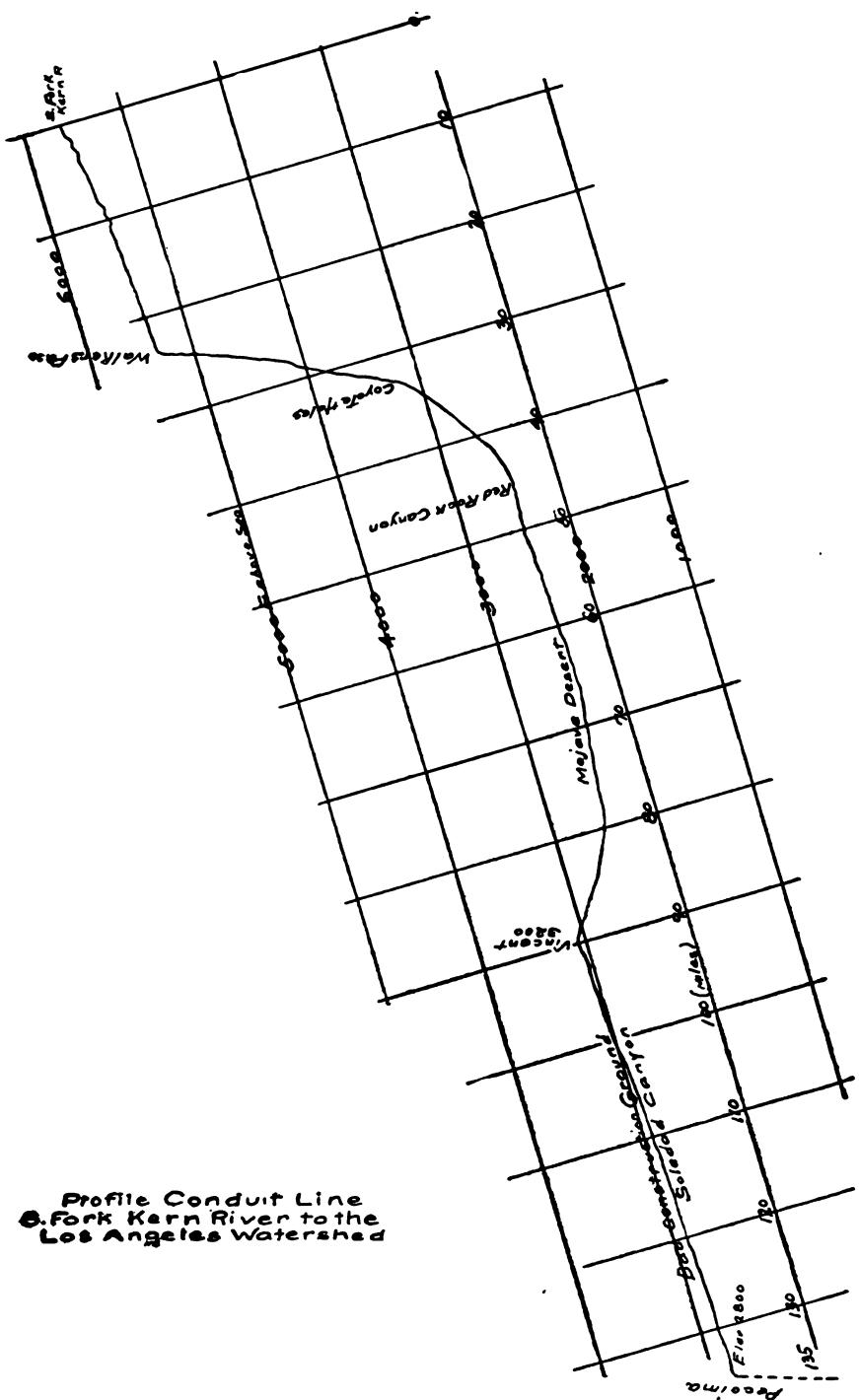
The last point in position there is also some doubt, for the data is not in existence upon which to base anything but an opinion. This present season in Los Angeles, so far, there has been over twice the rainfall there was in the season of 1911-12. That is also true of Kernville. If any such increase has occurred in the Mono and Marmots, instead of 30 inches there may be 50 during this year, or even over the basin above the Monoche Meadows. Of the hundreds of stream measurements on the South Fork, which I have in my office, there is nothing over 10 second feet. Mr. Russell made one measurement of 30 second feet, and after a flood period had passed I have seen evidences that indicate to him that the flow must have been considerably over 1000 second feet. The records of the San Joaquin River, South Fork and Kern River, the month of the survey, will show an average of about 1000 cubic feet per second, or about 20 miles of effluent, when compared with the 1911-12 figures, and probably that slightly raised above the 1911-12 figures. Having a flow of 30 second feet to be delivered over those same 20 miles, a very large diversion would certainly be a better supply than the one in consideration.



WHITNEY CREEK DIVERSION (*See page 521*)

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In THE MENACHE RESERVOIR SITE (See page 52)

I make the following rough estimate of the cost of this proposition:

Monache Dam	\$ 200,000.00
Conduit: 24 miles to Walker's Pass	633,600.00
Conduit: 8 miles to Coyote Hole with power plant ..	1,000,000.00
Conduit: 38 miles to Trough in Desert	1,000,000.00
Pressure line, 20 miles and pumps	6,500,000.00
Conduit and structures on Soledad Section.....	2,112,200.00
Right of way, etc.	1,054,200.00

	\$12,500,000.00

Dated May 9th, 1905.

CONCLUSION.

In conclusion it may be stated:

First—That the water supply for the City of Los Angeles and suburban towns is now maintained with difficulty by the use in part of temporizing expedients. It will be necessary to obtain an additional supply, amounting to approximately sixty cubic feet per second, within a period of twenty years, for strictly domestic purposes alone. The need for a greater domestic supply is so urgent as to demand prompt relief. In providing for the future an increase in area within the city limits should be considered as well as a greater population.

Second—that it would not be wise economy for the City of Los Angeles to endeavor to obtain its additional water from the gravel beds of Southern California, these underground waters are already overappropriated and failing. The city could not obtain additional water therefrom without the expensive condemnation of highly developed horticultural districts, including many towns and villages. This manifestly should be avoided except as a last resort. It is not feasible to obtain an adequate supply from any of the streams of Southern California to broadly solve the water problem confronting Los Angeles. A partial relief could be obtained at a high expense by storing the flood water of the Mohave River at the Victor reservoir site. However, this water should be used in the San Bernardino Valley.

Third—Any waters to the extent of 500 second feet that can be obtained in addition to those actually needed for domestic consumption, could be used for the development of highly productive citrus foothill lands immediately surrounding the city. Doubtless these lands if irrigated, would soon become densely populated suburban additions to a Greater Los Angeles.

Fourth—The future development and prosperity of this section will be measured largely by the available water supply. Its value to the city would and should justify a generous treatment of those from whom rights are purchased.

This report, owing to possible conflict with other duties, must be confined

to a consideration of the waters of Southern California alone. The study of the northern Inlet, from which it may be possible to find relief, has been assigned to other able engineers inspired with a full comprehension of the problem and the results to follow its accomplishment.

Respectfully submitted,

WM. MULHOLLAND,
LIPPINCOTT & PARKER.

Superintendent's Report

For the Year Ending November 30, 1905

Engineering and Construction Dept. City Water Works

To the Honorable Board of Water Commissioners of the City of Los Angeles:

Gentlemen: In presenting this, the Fourth Annual Report of the Engineering and Construction Department of the Water Works, it will be unnecessary to do much more than refer you to the tables that are herewith submitted to enable you to review the extraordinary efforts that have to be put forth to enable the Department to keep pace with the marvelous growth of the city.

Our greatest anxiety does not however, arise from our inability to supply and lay pipe to reach the many new and distant tracts that are being built up, but rather in the more serious problem involved in supplying them with water.

The comparatively heavy rainfall of last winter came as a great relief, and without doubt served to arrest the further recession of the stream flow of the river which had been constantly diminishing since 1893. Its average amount for the past year, neglecting the occasional flood flows of last winter, was 46.85 second feet, or 30,265,000 gallons daily down to the point of last gravity diversion at the Crystal Springs gate house. The minimum observed flow, that of September 27, was 41.14 second feet, or 26,575,000 gallons.

Throughout the summer months our average daily rate of consumption was about 34 million gallons, the deficiency in quantity between that amount and the flow of the stream being made up by water extracted from the Narrows Gallery and the Slauson Avenue Pumping plant which has been installed and put in operation since the last annual report.

By reference to last year's report, it will be seen that the mean daily consumption of the city for that year was practically the same as in the present year. When it is remembered that 600 services were added to the system in that period, indicating an addition of population of fully 30,000 people, or about 15 per cent, the effect of the use of meters is shown, for it was by their use alone, in checking waste, such a result was attained.

In view of the fact that the largest and the most wasteful consumers have been pretty generally metered throughout the city, and of the further fact that the per capita consumption has been reduced to about the average of cities of this size in the United States, it is not probable that the further extension of the meter system will result in any very considerable reduction of such consumption. The application of meters, however, should be continued as far as our means will permit, until all the services have been metered.

There were periods during the summer, as there are during every summer, when the demand for water exceeded the average daily consumption by 20 per cent, these periods sometimes lasting a week or more. During two or three such spells last summer the reservoirs were more than half emptied notwithstanding our greatest efforts to maintain them at their normal level. To partly obviate this condition we are at present constructing a reservoir on a portion of the

ground on which is situated the Ivanhoe reservoir site, but at a higher level than the elevation designed for the larger reservoir. This reservoir will be used in connection with the High Gravity System, and by adding to our stored water some 50 million gallons of capacity will serve to reduce the danger from those exceptionally heavy drafts.

The Stanton Avenue Pumping Station by its product has fully come up to expectations and has a capacity, as predicted, of over 4 million gallons daily.

The Narrows Gallery yields about 5 million gallons daily, and observation of its action would seem to indicate that from 1½ to 2 million gallons additional may be produced therefrom by boring wells intermediate to the present ones leading into it.

In pursuance of the plans outlined in the First Annual Report, work was begun on an infiltration gallery on the Pomeroy and Hooker land at the head of the Main Supply Conduit. This is designed to extract by gravity the stream flow at that point from the sub-surface gravels underlying the river. There has always been great danger of contamination of the water above this point by encroachment on the bed of the stream, of cattle and campers, and it is the design of this gallery to guard against such result. The work has already progressed from the upper end of the Main Supply Conduit a distance of 408 feet, and is at its shallowest point over 20 feet beneath the bed of the river. Work was suspended thereon about the first of November as it would be dangerous to carry on its construction during the winter months when sudden floods are likely to occur. It is now producing about 3¼ million gallons daily and the water produced from it is of exceptional purity. It is the intention to carry this work on until the entire surface stream disappears, but work cannot be resumed on it until late in the spring, for the reasons before stated.

The purchase of the Pollock place by the department will afford an added source of water for occasional periods of high consumption. Wells are now being put down thereon, the deepest of which has penetrated 179 feet being absolutely continuous in water bearing gravel. The contract has already been let for the machinery to be installed on the property, and consists of a 125-horse-power 3-cylinder vertical gasoline engine of modern type, driving a No. 12 centrifugal pump to extract water from five or more wells and discharging it into the closely adjacent Buena Vista conduit.

From present indications of the formation penetrated by the wells the yield of this plant may be expected to reach a total of between 5 and 6 million gallons daily, but like nearly all works of this character it cannot be expected to yield continuously at that rate with any degree of permanency.

**STATEMENT OF PIPE LAID DURING THE YEAR ENDING
NOVEMBER 15, 1905.**

Location.	Size	Length
	Inches	Feet
First Street, Ensign to Occidental Boulevard	4	234
Third Street, At Lucas and West	4	421
Seventh Street, Hoover St., to west of Wilshire Pl	4	2179
Seventh Street, Berendo St., to east of Vermont.....	4	825

	Size Inches	Length Feet
Eighth Street, between Westmoreland & Vermont	4	602
Eighth Street, E. of Elden St., to west of Westmoreland.....	4	872
Tenth Street, from Menlo St., line E. to Menlo St., line W..	4	102
Tenth Street, Alameda to Lawrence St.	4	697
Eleventh Street, W. of Cahuenga to Gramercy Place	4	1564
Seventeenth Street, Central to Naomi	4	891
Eighteenth Street, Wilton Place to Manhattan Place	4	1308
Eighteenth Street, Hoover to Arapahoe St.	4	355
Twenty-first Street, E. of Bonsallo to Toberman St.	4	1513
Thirtieth Street, Kansas St. to Vermont Ave.	4	656
Thirty-seventh Street, At Maple Ave. & W.	4	183
Thirty-seventh Street, Wall to San Julian St.	4	285
Forty-eighth, Compton Ave. to W. of Hooper St.	4	1662
Fiftieth Street, W. of Hooper St. to Compton Ave	4	1359
Fifty-first Street, At Hooper Ave.	4	21
Fifty fifth Street, South Park to Walrath St.	4	671
Fifty fifth Street, San Pedro to Walrath St.	4	830
Fifty fifth Street, Between San Pedro & Main Sts.	4	1041
Fifty-sixth Street, At South Park	4	24
Fifty-sixth Street, At Main St. & West	4	1264
Fifty-sixth Street, South Park to West of San Pedro St.	4	1709
Fifty-seventh Street, At South Park	4	24
Avenue 20, Darwin to Mozart	4	602
Avenue 20, At Mozart and North	4	294
Avenue 23, N. of Pasadena Ave. to Santa Fe R. of W.	4	1559
Avenue 60, Pasadena Ave. to Hays St.	4	867
Adams Street, At Hooper and East	4	1080
Aldama Street, New York St. to Ave. 57	4	1790
Albany Street, Pico to 16th St.	4	1210
Anderson Street, Aliso to Kearney St.	4	1114
Ann Street, Main Street to south of Magdalena St.	4	553
Berendo Street, North and South of 7th St.	4	1102
Bellevue Avenue, At Waterloo St.	4	25
Bloom Street, Main to South of Magdalena St.	4	624
Budlong Street, Wilshire Blvd. to N. of 6th St.	4	1733
Cimarron Street, At Washington St. and North	4	645
Cimarron Street, At 21st and south	4	197
Cimarron Street, Adams St., to 28th	4	1017
Crocker Street, 5th to 7th Street	4	1571
Custer Street, At Sunset Boulevard	4	23
Dewey Street, 11th to 12th Street	4	658
Delong Street, Pico to 16th Street	4	1293
Elmyra Street, Main Street to south of Magdalena St ..	4	619
Ensign Avenue, Temple St. to 1st St.	4	1249
Estrella Avenue, Washington St. to 23rd St.	4	1444
Evergreen Avenue, Brooklyn Avenue to Wabash St.	4	2584
Fedora Street, 11th St. to 12th St.	4	666
Flora Street, Prichard St. to Sierra St.	4	300

	Size Inches	Length Feet
Ganahl Street, Wabash St. to South of Fairmount St.....	4	550
Ganahl Street, Houston St. to Brooklyn Ave.	4	1828
Garey Street,, At 3rd St.	4	47
Georgia Street, Pico St. to 16th St.	4	1292
Gramercy Place, N. & S. of 18th St	4	1167
Gramercy Place, At 16th St. & South	4	115
Gramercy Place, 11th to N. of 10th St.	4	774
Grattan Street, 9th Street to 11th Street	4	1286
Hewitt Street at 3rd Street	4	47
Hope Street at Santa Monica Ave. & N.	4	17
Hooper Avenue, 50th Street to 51st Street.....	4	326
Hooper Avenue, Huber St. to 48th St.	4	265
Isabel Street, W. of Glenalbyn to junction of Pepper St...4	4	614
Johnston Street At Baldwin St. & N.	4	636
Kansas Avenue, 29th to Jefferson St.	4	1210
Lake Street, At Hoover St. and N	4	70
Lasalle Street, At Washington St. and South	4	120
Leroy Street, Main St. to St. James St.	4	605
Leeward Avenue, Hoover St. to Vermont Avenue	4	2194
Loma Drive, Silver St. to Gravilla St.	4	991
Long Beach Avenue, At 51st St. & South	4	523
Magnolia Avenue at 11th St. and South.....	4	614
Magnolia Avenue at Washington St. and N.....	4	23
Manhattan Place at 18th St. and South.....	4	574
Manhattan Place at Washington St. and North.....	4	45
Manhattan Place at 11th St. to N. of 10th St.....	4	1129
McClintock Avenue, Jefferson St. to 40th St.....	4	1878
Menlo Avenue N. & S. of 10th St.....	4	748
Mission Road at Workman St. & E.....	4	213
Mozart Street at Ave. 20.....	4	69
Moneta Avenue, N. of 45th St. to S. of 47th St.....	4	885
New Hampshire Street, Pico St. to Washington St.....	4	2637
New Hampshire Street, N. of 7th St. to S. of 8th St....	4	1990
New York Street, Philadelphia St. to Mesa St.....	4	707
Ottawa Street, Figueroa St. to Georgia St	4	860
Occidental Boulevard, N. & S. of Eldorado St.....	4	1326
Occidental Boulevard, between 1st St. & 6th St.....	4	1184
Occidental Boulevard, at 1st St. & South.....	4	70
Orange Street, at Hoover & W.....	4	848
Prichard Street, Pomona St. to Flora St.....	4	660
Pepper Street, between Isabel St. & Pepper St.....	4	1007
Romeo Street, Adams St. to 27th St.....	4	776
St. Andrew's Place, N. & S. of 18th St.....	4	1178
St. Andrew's Place, 11th St. to N. of 10th St.....	4	1054
Silver Street, Witmer Street to Loma Drive	4	648
Sierra Street, at Flora St. & N.....	4	229
Solano Avenue, N. & S. of Yuba St.....	4	1423
South Park Avenue, N. & S. of 55th St.....	4	483

	Size Inches	Length Feet
South Park Avenue, at 56th St. & South.....	4	315
South Park Avenue, at 57th St. & South.....	4	216
Stephenson Avenue, Chicago St. to Soto St.....	4	1036
Sunset Boulevard at Hill St.....	4	31
Temple Street, Ensign Ave. to W. of Fanning St.....	4	558
Towne Avenue, 6th St. to 7th St.....	4	767
Valencia Street at 7th St.....	4	30
Wall Street, 37th St to 40th St.....	4	1491
Waterloo Street, Marathon Ave. to Bellevue Ave.....	4	1261
Wesley Avenue, Jefferson St. to 38th St.....	4	1233
Western Avenue, 11th St. to N. of 10th St.....	4	1114
Wilton Place, N. & S. of 18th St.....	4	1194
Witmer Street at 3rd St. & North.....	4	430
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Total, Size 4, laid to Nov. 15, 1905.....		93,810

21st Street, Figueroa St. to W. of Estrella St.....	5	953
Second Street, Alameda to Santa Fe Ave.....	6	1613
Third Street, Wall St. to E. of San Pedro St.....	6	926
Third Street, at Alameda St.....	6	24
Third Street, Stephenson Ave. to Santa Fe Ave.....	6	1656
Third Street, Olive St. to Bunkerhill Ave.....	6	602
Eighth Street, Central Ave. to Tennessee St.....	6	1324
Ninth Street, Mateo St. to Santa Fe Ave.....	6	692
Fourteenth Street, at Central Ave. & East.....	6	663
Fourteenth Street, at Hawthorne St. & East.....	6	679
Fourteenth Street, Tennessee St. to Alameda St.....	6	1247
Twenty-third Street, Figueroa St. to Scarff St.....	6	1855
Twenty-fourth Street, San Pedro St. to Central Ave.....	6	2089
Twenty-ninth Street, at Hoover St. & West.....	6	1056
Thirty-eighth Street, McClintock Ave. to Hough St....	6	636
Fortieth Street, Main St. to E. of Wall St.....	6	809
Fortieth Street, San Julian St. to San Pedro St.....	6	994
Fifty-sixth Street, Compton Ave. to W. of Azot Ave.	6	776
Fifty-sixth Street, Central Ave. to E. of Hooper Ave....	6	1361
Twenty-ninth Street, Maple Ave. to East of Trinity St..	6	1419
Avenue 37, Dayton Ave. to Isabel St.....	6	373
Alameda Street, 14th to 16th St.....	6	881
Alameda Street, 16th St. to Washington St.....	6	1140
Alta Street, Downey Ave. to Pomona St.....	6	1725
Berkeley Street, Lakeshore Ave. to Alvarado St.	6	726
Boyle Avenue, Stephenson Ave. & South.....	6	91
Dayton Avenue, Avenue 37 to Pasadena Ave.	6	635
Defiance Avenue, San Pedro St. to South Park Ave.	6	896
Elysian Park Drive, Chavez Ravine Road to Scott St. ...	6	1047
Euclid Avenue, 6th St. to Stephenson Ave.	6	1297
Flower Street, 6th St. to 7th St.....	6	666
Flower Street, 7th St. to 8th St.....	6	639

	Size Inches	Length Feet
Grand Avenue, 6th St. to 7th St.....	6	663
Grand Avenue, at 7th St. & South.....	6	64
Hope Street, 6th St. to 8th St.....	6	1354
Isabel Street, Avenue 37 to W. of Glenalbyn Drive.....	6	1678
Jefferson Street, at Kingsley St. & West.....	6	199
Jefferson Street, at San Pedro St. & East.....	6	87
Jefferson Street, E. of San Pedro St. to Eureka St.....	6	1622
Lakeshore Avenue, Scott St. to Berkley St.....	6	509
Normandie Avenue, at Adams St.....	6	60
Oak Street, 16th St. to Washington St.....	6	1273
Pomona Street, Alta St. to Prichard St.....	6	362
Santa Fe Avenue, 7th St. to Violet St.....	6	744
Santa Fe Avenue, S. of Violet St. to N. of Porter St.....	6	2104
Santa Fe Avenue, at Porter St. & South.....	6	427
Santa Fe Avenue, 9th St. to Butte St.....	6	2682
Santa Fe Avenue, Willow St. to 7th St.....	6	1650
Scott Street, from Elysian Park to Lakeshore Ave.....	6	2453
State Street, at Marengo Ave.....	6	20
Stephenson Avenue, at Boyle Ave.....	6	68
Sunset Boulevard, Centennial St. to Beaudry Ave.....	6	720
Tennessee Street, at 8th St. & South.....	6	583
Tennessee Street, at 14th St.....	6	60
Tennessee Street, 9th St. to 16th St.....	6	2284
Washington Street, at Alameda St.....	6	38
Wabash Avenue, at Soto St. & East.....	6	1274
Wabash Avenue, Dobinson St. to Evergreen Ave.....	6	1291
Willow Street, Mateo St. to Santa Fe Ave.....	6	670
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Total 6-inch pipe laid to Nov. 15, 1905.....		55,956

Second Street, San Pedro St. to Alameda St.....	8	1418
Aliso Street, Vignes St. to Center St.....	8	550
Alvarado Street, Montrose St. to Sunset Boulevard.....	8	439
Belmont Avenue, Bellevue Ave. to Kane St.....	8	388
Bonnie Brae Street, Kane St. to Montrose St.....	8	1237
Boyle Avenue, Stephenson Ave. to N. of St. Louis St.....	8	525
Ida Street, Sunset Boulevard to Temple Road.....	8	2672
Kane Street, Belmont Ave. to Bonnie Brae St.....	8	703
Montrose Street, Bonnie Brae St. to Alvarado St.....	8	521
Olive Street, 9th St. to N. of 8th St.....	8	1224
Olive Street, at 7th St. & South.....	8	132
Soto Street, Wabash Ave. to Sheridan St.....	8	1278
Sunset Boulevard, at Figueroa St.....	8	56
Sunset Boulevard, Echo Park Road to Lakeshore Ave.....	8	1091
Temple Street, at Junction of Temple Road & Burtz.....	8	34
Temple Road, Ida St. to Temple St.....	8	651
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Total 8-inch pipe laid to Nov. 15, 1905..... 12,919

	Size Inches	Length Feet
Seventh Street, Alameda St. to Santa Fe Ave.	10	2373
Aliso Street, Alameda St. to Vignes St.	10	1498
Marengo Avenue, Cosme St. to Soto St.	10	1170
Soto Street, Marengo Ave. to Wabash Ave.	10	652
Vernon Avenue, at Compton Ave.	10	51
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Total 10-inch pipe laid to Nov. 15, 1905.		3,944

Third Street, at Alameda St.	12	36
Fourth Street, Merrick St. to Molino St.	12	97
Seventh Street, at Alameda St.	12	40
Thirty-eighth Street, Central Ave. to Compton Ave.	12	2782
Avenue 21, Downey Ave. to Main St.	12	2733
Aliso Street, at Alameda St.	12	37
Compton Avenue, Adams St. to Vernon Ave.	12	4145
Compton Avenue, at Vernon Ave.	12	44
Jefferson Street, Maple Ave. to San Pedro St.	12	1431
Marengo Avenue, Cosme St. to W. of Safford St.	12	2475
Marengo Avenue, at Mission Road & South.	12	601
Main Street, Avenue 21 to Workman St.	12	812
Main Street, at Marchemault St. & South.	12	127
Mateo Street, at 7th St.	12	80
Mateo Street, Palmetto St. to 7th St.	12	2087
Mateo Street, 7th St. to 9th St.	12	3092
Merrick Street, Stephenson Ave. to 4th St.	12	359
Mission Road, Workman St. to Marengo Ave.	12	300
Molino Street, at 4th St. & South.	12	729
Molino Street, at Palmetto St. & North.	12	218
Pasadena Avenue, New York St. to S. of Avenue 61.	12	1929
Palmetto Street, Molino St. to Mateo St.	12	216
South Park Avenue, Jefferson St. to Vernon Ave.	12	4183
Vernon Avenue, at South Park.	12	24
Vernon Avenue, between S. Park Ave. & Towne Ave.	12	626
Vernon Avenue, W. of South Park Ave.	12	12
Vernon Avenue, Main St. to West of Woodlawn Ave.	12	379
Vernon Avenue, Woodlawn Ave. to E. of Towne Ave.	12	1605
Washington Street, Hoover St. to E. of Arapahoe St.	12	321
Washington Street, at Vermont Ave. & East	12	52
Washington St., E. of Arapahoe St. to W. of Magnolia	12	489
Washington Street, Vermont Ave. to New England St.	12	1098
Washington Street, at New England St. & East	12	346
Workman Street, Main St. to Mission Road	12	1913
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Total 12-inch pipe laid to Nov. 15, 1905		35,317

	Size Inches	Length Feet
Compton Avenue, at Shanno Ave. Pump Station	1 1/2	39
Compton Avenue, South Park Ave. to Central Ave.	1 1/2	2658
Total 16-inch pipe laid to Nov. 15, 1905		<u>2,697</u>
12-inch Street, at James & East	1 1/2	345
12-inch Street, Madison St. to Elm Drive	1 1/2	366
12-inch Street, James St. to Brooks St.	1 1/2	354
Total 12-inch pipe laid to Nov. 15, 1905		<u>1,065</u>
10-inch Street, Edge St. to Bonner St.	20	373
10-inch Street, Monroe St. to Franklin St.	20	207
Monroe Avenue, Franklin Ave. to Compton Ave.	20	1647
Total 10-inch pipe laid to Nov. 15, 1905		<u>2,227</u>
Compton Ave., Vernon Ave. to Shanno Ave. Pump Sta.	24	7162
12-inch Street, at High Street, Rossmoor	24	50
Total 12-inch pipe laid to Nov. 15, 1905		<u>7,200</u>

Summary of Pipe Laid During the Year Ending November 15, 1905.

1	93,810
2	963
3	55,266
4	12,919
5	5,944
6	46,317
7	3,097
8	1,066
9	3,227
10	5,322
Total	217,710—41.23 Miles

PIPE HYDRANTS.

In System Nov. 15, 1904	961
Single Hydrants placed during year	199
Double Hydrants placed during year	23
Total In System Nov. 15, 1905	1,183

SERVICES.

In System Nov. 15, 1904.....	39,558
Added during the year ending Nov. 15, 1905.....	6,608

Total Services	46,166

SERVICES BY WARDS

Put In During the Year Ending November 15, 1905.

Size.	Wards.									Total.
	1	2	3	4	5	6	7	8	9	
1 $\frac{1}{2}$ inch	584	632	52	369	1184	1495	121	36	781	5654
1 $\frac{3}{4}$ inch	73	62	73	238	214	84	19	10	43	816
1-inch	6	5	9	21	25	12	9	2	2	91
1 $\frac{1}{2}$ -inch	1	0	5	2	1	2	7	1	0	19
2-inch	1	3	1	2	0	3	4	1	0	13
3-inch	0	0	1	0	0	0	0	0	1	2
4-inch	0	1	0	0	1	0	0	0	0	2
6-inch	0	0	1	0	0	0	1	0	0	2
	—	—	—	—	—	—	—	—	—	—
Total	665	703	142	632	1425	1996	161	50	827	6601

Services ordered and not placed, old services having been found in the ground

7

6608

GATES

Placed During the Year Ending Nov. 15, 1905.

Size.	
4-inch	123
6-inch	97
8-inch	28
10-inch	9
12-inch	26
16-inch	2
18-inch	2
20-inch	2
24-inch	2
	—
Total	291

TOTAL NUMBER OF METERS IN SERVICE NOV. 15, 1905.

(City and Private.)

Kind.	%	%	Sizes (Inches).					Total.
			1	1½	2	3	4	
Trident	3053	2260	64	11	21	2	0	5411
Nash	1254	1	3	53	7	0	1	1319
Lambert	393	312	88	0	3	2	0	800
Empire	153	22	256	88	20	18	10	569
Keystone	128	141	107	13	9	0	0	398
Crown	113	44	5	1	12	3	0	180
Hershey	53	4	8	0	3	0	0	68
Worthington	56	0	0	0	0	0	0	56
Columbia	29	0	0	0	0	0	0	29
Union Rotary	1	0	1	0	0	0	0	2
—	—	—	—	—	—	—	—	—
Totala in sizes.....	3239	2794	532	166	75	25	11	8832
Number of meters in use Nov. 15, 1904.....								3485
—								—
Number placed during the year ending Nov. 15, 1905.....								5347

NOTE: Of the above 376 are owned by private parties.

The Works in general, though still lamentably backward by reason of the rapid extension of the city, are in good condition, the pump equipment being amply able to take care of all the demands made on it. The reservoirs are also in good order, and with the exception of the few flood periods of last winter the water supplied has been of better quality than during any preceding period in the history of the Works.

The employees are deserving of high praise for their industry, efficiency and general devotedness to the good of the service during the year.

I beg, for myself and fellow employees, to express my appreciation of the hearty manner in which your Honorable Body has encouraged our labors.

Respectfully,

WM. MULHOLLAND.

Superintendent.

Water Works Financial Report

For the Year ending November 30, 1905

Los Angeles, Cal., Dec. 15, 1905.

To the Honorable Board of Water Commissioners of the City of Los Angeles:—

Gentlemen: I have the honor to herewith submit the Annual Report of the financial operations of the Water Department for the year ending November 30, 1905.

The statements following will not only show the amounts collected and expended through this office, but all amounts received and expended by the City for Water Works purposes during the year.

RECEIPTS.

Balance by last report.....		\$18,090.64
Water	792,787.36	
Permits	21,104.41	
Services	82,047.50	
Material and Labor	6,491.81	
Rents	1,873.25	
Meters	3,161.00	
Deposits for extension of mains..	13,546.15	
Deposit returned by Supt. of Streets..	1,000.00	
Uncalled for demand	4.25	
Return of money advanced to se- cure options	4,217.08	\$ 906,233.01
Sale of Water Works Bonds 1905..	1,500,000.00	
Premium and Interest, Bonds 1905..	17,246.33	
Sale of Reservoir Bonds 1904.....	150,000.00	
Premium and Interest Bonds 1904 ..	4,185.00	1,671,431.33 \$2,577,664.34

		92,595,754.98

DISTRIBUIDOR

Improvements and Additions to Plant.

General Construction (Pipe, etc.)	305,360.20
Machinery Construction (Pumps, etc.)	41,487.91
Water Development (Wells, etc.)	5,919.14
Reservoirs	15,346.96
Ivanhoe Reservoir	275.85
Head Works	21,049.43
Infiltration Gallery	6,341.81
Land and Buildings	237,501.07
Meters	48,025.56
Engr. Expense Owens River Line	5,769.42
	8727,077.85

OPERATING AND MAINTENANCE.

Water	\$ 6,851.14
Permit	141,855.47
Service	7,291.89
Sundries	67,121.87
Bond Interest	67,000.00
Rent	1,119.80
Meters	6,875.81
Gasoline	8,375.00
Total	12,684.12
Total at End of Year	\$ 339,324.62
	<hr/>
	December, Dec. 1, 1905
	<hr/> \$1,529,352.44

CONDITION OF FUNDS NOVEMBER 30, 1905.

Water Fund	\$ 211,968.18
Workers' Bond Fund	70,639.55
Workers' Bond 1906 Fund in Own	
Total Fund	1,240,134.71
	\$1,629,352.44

INTEREST AND SINKING FUNDS.

Workers' Bond 1905	1,624.00
Workers' Bond 1904	33,100.00
Workers' Bond 1903	24,687.50
Workers' Bonds 1904 (less)	9,234.37
	\$ 69,434.37
	\$1,598,766.2

RECEIPTS BY MONTHS.

December, 1905.

Water	\$ 63,919.36
Permit	1,618.00
Service	4,178.00
Sundries	204.10
Rent	419.50
Meters	150.00
	\$70,794.96

January, 1906.

Water	\$ 63,444.86
Permit	1,618.00
Services	4,178.00
Sundries	204.10
Rent	419.50
Meters	150.00
	\$70,535.49

February, 1905.

Water	\$ 63,092.50
Permits	1,850.40
Services	4,367.00
Sundries	225.00
Rent	218.00
Meters	152.00
Deposits	351.00
	\$70,255.90

March, 1905

Water	\$ 64,333.26
Permits	1,817.10
Services	5,676.00
Sundries	700.78
Rent	158.00
Meters	233.00
Deposits	1,315.50
Street Supt.....	1,000.00
	\$75,233.64

April, 1905.

Water	\$ 63,333.00
Permits	2,661.65
Services	6,358.00
Sundries	527.60
Rent	60.00
Meters	402.00
Deposits	2,373.50
Uncalled for Demand Can- celled	4.25
	\$75,720.00

May, 1905.

Water	\$ 66,229.68
Permits	1,464.85
Services	5,522.00
Sundries	690.17
Rent	78.00
Meters	279.00
Deposits Pipe Extensions.	943.25
	\$75,246.98

June, 1905.

Water	\$ 64,729.39
Permits	1,606.15
Services	5,570.(W)
Sundries	577.95
Rent	337.50
Meters	282.00
Deposits	2,124.30
	\$75,227.40

July, 1905.

Water	\$ 67,450.95
Permits	1,814.10
Services	4,891.00
Sundries	542.24
Rent	45.00
Meters	180.00
Deposits	1,752.00
From Reservoir Bonds....	150,000.00
Premium and Int., Bonds..	4,135.00
	\$230,860.29

August, 1905.

Water	\$ 66,964.95
Permits	1,698.85
Services	5,307.50
Sundries	155.65
Rent	68.00
Meters	157.00
Deposits	1,975.00
	\$76,326.95

September, 1905.

Water	\$ 67,943.45
Permits	1,553.10
Services	4,750.00
Sundries	246.55
Rent	68.00
Meters	224.00
Deposits	490.00
From F. Eaton Opt'n Fund	3,917.08
	\$79,192.18

October, 1905.

Water	\$ 70,014.90
Permits	952.44
Services	6,275.00
Sundries	1,270.49
Rent	108.00
Meters	360.00
Deposits	1,161.00
	\$80,141.83

November, 1905.

Water	\$ 71,336.32
Permits	2,154.20
Services	4,566.00
Sundries	975.96
Rent	116.25
Meters	613.00
Deposits	1,020.40
Water Works Bonds 1905.	1,500,000.00
Interest and Principal....	17,246.33
	\$1,598,028.46

DISBURSEMENTS BY MONTHS.

December, 1904.

	Salaries.	Material, etc.	Total.
General Construction	\$ 7,605.40	\$ 18,012.49	
Machinery Construction	50.00		
Water Development Construction	2,875.80		
Reservoir Construction	2,096.60	93.60	
Infiltration Gallery Construction	1,014.60	814.11	
Meters	5,859.97		
Operating	8,059.35	5,705.53	
Maintenance	377.28		
Deposits Returned	24.00		
	<hr/>	<hr/>	<hr/>
	\$18,835.95	\$ 33,312.78	\$ 52,148.73

January, 1905.

General Construction	\$ 6,739.45	\$ 21,057.08	
Machinery Construction	4,747.50		
Reservoir Construction	2,886.05	8.68	
Infiltration Gallery	1,140.00	244.75	
Meters	3,529.82		
Land and Buildings	285.50	37.19	
Operating	7,726.30	3,759.34	
Maintenance	466.90	134.53	
Deposits Returned	23.50		
	<hr/>	<hr/>	<hr/>
	\$19,244.25	\$ 33,575.69	\$ 52,819.94

February, 1905.

General Construction	\$ 6,702.60	\$ 4,738.14	
Machinery Construction	3,829.21		
Water Development Construction	1,670.85		
Reservoir Construction	2,844.85	30.51	
Infiltration Gallery Construction	1,144.00	440.72	
Meters	2,324.65		
Land and Buildings	3,998.13		
Operating	9,932.15	4,345.64	
Maintenance	423.80	19.56	
	<hr/>	<hr/>	<hr/>
	\$21,047.45	\$ 22,397.41	\$ 43,444.86

DISBURSEMENTS—Continued
March, 1906.

	Salaries	Material, etc.	Total
General Construction	\$ 6,941.10	\$ 8,127.56	
Machinery Construction		5,034.84	
Reservoir Construction		1,138.10	
Infiltration Gallery Construction	827.00	325.79	
Meters		844.06	
Land and Buildings		4,695.42	
Water Investigation	389.33		
Operating	8,131.05	2,275.04	
Maintenance	430.25	166.60	
Deposits Returned		51.80	
	\$16,718.73	\$ 22,659.21	\$ 39,377.94

April, 1906.

General Construction	\$ 6,731.85	\$ 18,428.04	
Machinery Construction		11,636.12	
Reservoir Construction	1,769.65	30.55	
Headworks	595.85	13.43	
Infiltration Gallery Construction		375.64	
Meters		4,001.50	
Land and Buildings		2,305.53	
Water Investigation	599.07		
Operating	3,804.95	2,181.74	
Maintenance	507.10	639.11	
Deposits Returned		3.50	
	\$18,998.47	\$ 39,616.16	\$ 58,614.63

May, 1906.

General Construction	\$ 9,810.40	\$ 24,234.06	
Machinery Construction		8,283.06	
Reservoir Construction	678.50	1,703.53	
Headworks		43.60	
Infiltration Gallery Construction		14.20	
Gas		2,582.70	
Land and Buildings		2,420.60	
Water Investigation	787.95		
Operating	4,348.90	1,629.50	
Meters	487.30	25.54	
Deposits Returned		73.00	
	\$19,466.95	\$ 41,011.79	\$ 60,988.74

DISBURSEMENTS—Continued

June, 1906.

	Salaries	Material, etc.	Total
General Construction	\$ 9,950.80	\$ 41,019.67	
Machinery Construction		4,029.65	
Reservoir Construction		1,250.00	
Headworks Construction.....	1,249.85	5,188.86	
Meters		2,278.85	
Land and Buildings		61,995.22	
Water Investigation	2,091.54		
Operating	8,528.63	2,192.65	
Maintenance	421.50	74.25	
Deposits Returned		21.00	
	<hr/>	<hr/>	<hr/>
	\$22,242.32	\$118,050.15	\$140,292.47

July, 1906.

General Construction	\$ 8,337.60	\$ 34,594.60	
Headworks	997.05	2,835.27	
Meters		3,712.90	
Land and Buildings		40,494.71	
Water Investigation	99.10		
Operating	8,950.10	2,008.21	
Maintenance	393.55		
Deposits Returned		427.00	
	<hr/>	<hr/>	<hr/>
	\$18,777.40	\$ 86,072.69	\$104,850.09

August, 1906.

General Construction	\$ 7,626.85	\$ 8,306.94	
Machinery Construction		1,280.65	
Headworks	2,314.35	529.42	
Meters		1,961.50	
Land and Buildings		773.91	
Water Investigation	931.55		
Interest and Sinking Fund		154,121.87	
Operating	9,223.85	3,609.15	
Maintenance	394.20	380.16	
Deposits Returned		190.00	
	<hr/>	<hr/>	<hr/>
	\$90,490.80	\$171,182.80	\$161,682.80

DISBURSEMENTS—Continued

September, 1905.

	Salaries	Material, etc.	Total
General Construction	\$ 3,168.45	\$ 10,141.26	
Machinery Construction		578.07	
Water Development Construction	365.87		
Headworks Construction	2,759.95	1,168.85	
Meters		2,936.56	
Land and Buildings		54,650.68	
Water Investigation	437.15		
Operating	10,307.40	2,465.43	
Maintenance	481.05		
	<hr/> \$22,499.37	<hr/> \$ 71,940.65	<hr/> \$ 94,440.52

October, 1905.

General Construction	\$ 3,502.15	\$ 140.58
Headworks	1,996.60	
Meters		95.00
Land and Buildings		55,511.50
Water Investigation		110.00
Eng. Exp. Owens River Line		853.29
Exp. San Fernando Case	4,360.00	
Operating	9,517.10	932.54
Maintenance	460.55	
Deposits Returned		180.00
	<hr/> \$24,837.00	<hr/> \$ 57,722.91
		<hr/> \$ 82,559.91

November, 1905.

General Construction	\$ 7,708.60	\$ 21,653.88
Machinery Constructing		18.81
Water Development Construction	517.00	969.62
Reservoir Construction		816.34
Headworks	981.15	375.80
Ivanhoe Reservoir	375.95	
Meters		15,898.05
Land and Buildings		50,332.68
Water Investigation		1,845.90
Eng. Exp. Owens River Line	1,034.00	3,552.13
Operating	9,329.60	4,599.27
Maintenance	491.95	141.66
Deposits Returned		124.00
Exp. San Fernando Case	2,112.30	103.50
Interest on Land Contracts		9,375.00
L. A. City, Exp. of Bond Issue		12,634.12
	<hr/> \$22,550.55	<hr/> \$122,790.76
		<hr/> \$145,241.31

TOTAL RECEIPTS.

February 4, to November 30, 1902	\$456,317.83
Year ending November 30, 1903	614,264.92
Year ending November 30, 1904	772,978.32
Year ending November 30, 1905	906,233.61
Year ending Nov. 30, 1905 (Bonus)	\$1,671,131.33
	2,577,064.34

	\$4,621,225.41

TOTAL DISBURSEMENTS.

February 4 to November 30, 1902	\$314,163.56
Year ending November 30, 1903	733,493.13
Year ending November 30, 1904	777,813.74
Year ending November 30, 1905	1,066,102.54
	\$2,891,872.97
Balance December 1, 1905	\$1,529,352.44

BONDS.

	Year Issue	Rate	Original Amount	Outstanding
Water System Improvement	1895	4 1/2%	\$ 300,000.00	10,500.00
Water Works	1901	3 1/2%	2,000,000.00	1,800,000.00
Water Works	1904	3 1/2%	337,500.00	125,000.00
Water Works Reservoir	1904	3 1/2%	150,000.00	146,250.00
Water Works (Owens River Line)	1905	4 1/2%	1,500,000.00	1,500,000.00
			-----	-----
			\$6,917,500.00	\$3,793,750.00

FACE OF LEDGER DECEMBER 1, 1905.

Water	\$2,451,502.83
Permits	51,305.58
Rent	4,202.25
City of Los Angeles	82,876.12
Zanja	\$ 3,071.50
Water Works Bonds,	
1904 (Reservoir)	146,250.00
1905 (Owens River Lands)	1,500,000.00
1901	1,800,000.00
1895	22,500.00
1904	325,000.00
Interest	296,071.79
Land and Buildings	250,711.92
Land and Buildings	43,980.20
Land and Buildings	59,065.34
Meters	79,168.36
General Construction	3,223,557.60
Mach. "	107,826.46
Water Development Con.	23,617.67
Maintenance	22,678.08
Water Investigation	7,291.49
Funds, Bonds 1905	1,246,734.71
Res., Bonds 1904	70,659.55
Water Revenue	211,958.18
Interest & Sinking, 1895	1,762.50
Interest & Sinking, 1901	33,750.00
Interest & Sinking, 1904	24,687.50
Interest & Sinking, Res. 1904	9,234.37
Eng. Exp. O. R. Line	5,469.42
Exp. San Fernando Case	6,575.80
Operating	359,195.05
Deposits	767.50
Deposits	18,550.15
Ivanhoe Reservoir	275.95
Res. Construction	83,513.51
Head Wks. Constr.	33,736.08
Infiltration Gallery	37,364.26
Conduit	154,997.14

	\$6,396,954.43

	\$6,396,954.43

LAND INSIDE CITY.

	Assessed Val.	Appraised Val.
East Side Springs, Mullaly's Addn.	\$ 500.00	\$ 1,200.00
Hazard Reservoir, Lots 1 & 2, Blk. 4 Florence Ter	150.00	700.00
Hazard Reservoir, 2 acres	400.00	2,000.00
Victor Hts. Tr., Lots 133 to 144 Incl.	2,640.00	6,000.00
Beaudry Res. Site	1,750.00	4,000.00
Angelino Res. Site, One acre	360.00	1,000.00
Lot 31½, Hunter's Highland View Tr., 8 acres	2,000.00	4,000.00
Lots 21, 22, 23, 24, Blk. 28, DeSoto Hts. Tr.	160.00	800.00
Lot 45, Blk. 3, Augusta Hts. Tr.	40.00	200.00
Corner Alameda & Marchesault Sts., (Old Office) ...	5,000.00	15,000.00
2.65 Acres, Bet. Buena Vista Tr. and Elysian Park ...	1,060.00	2,500.00
Bellevue Reservoir, 8 acres	1,200.00	2,400.00
Bellevue Reservoir, Lots 6 to 12 Incl.	225.00	440.00
Block G, Lincolnian Hts	560.00	3,500.00
Highland Reservoir, 10 acres	2,560.00	10,000.00
Yards, Bounded by Rose, Alameda, 2nd & Stephenson ...	4,480.00	20,000.00
Reservoir No. 5, 24 acres ...	10,000.00	20,000.00
Solano Reservoir Site	1,100.00	2,200.00
Ivanhoe Res. Site, Shepherd Lands	5,850.00	21,000.00
Slawson Ave. Pump Sta. N. E. Cor. Compton Ave.	4,400.00	15,000.00
-----	-----	-----
	\$44,435.00	\$131,940.00

LAND IN COUNTY.

Portions of Lots 18, 19, & 21, Blk. 3, Ivanhoe	\$ 100.00	
Ivanhoe Res. Site, Bd. by Clyde, Rowena, Maxwell & Ettrick Sts.	5,000.00	
Lot 9, Blk. 1 & Lot 50 Blk. 3, Ivanhoe	500.00	
Portion of Lot 21, Blk. 31, Ivanhoe	200.00	
Land Bd. by Lick Tr. & Griffith Land and River, 43 ½ Acres	4,362.00	
Lot 7, Blk. 41, Providence & Scott Tr	22.60 " "	2,260.00
Crystal Springs Land	4.09 " "	400.00
In Rancho San Rafael	32.00 " "	3,200.00
Darby Reservoir Site	9.052 " "	1,400.00
In Ro. San Rafael, Bd. South by Ro. Los Feliz	23.15 " "	2,315.00
Pomeroy & Hooker Lands	314.82 " "	31,482.00
Lands in Rancho Providence	285.00 " "	28,500.00
Lands in Rancho Providence, West Side Purchase	358.00 " "	35,800.00
High Service Reservoir, Garvanza, about	1 " "	1,000.00
Pollock Place, in Ro. Los Feliz	4 " "	5,000.00
Reservoir No. 7	11 " "	50,000.00
-----	-----	-----
	\$304,759.00	<b">694,760.00</b">
-----	-----	-----
Total Valuation	\$1,003,519.00	<b">\$1,003,519.00</b">

All of which is respectfully submitted,

L. M. ANDERSON,
Auditor.

مکانیزم ایجاد این پدیده را می توان با در نظر گرفتن این دو عوامل بررسی کرد.

برای این منظور از آنچه در مقاله های اخیر از این مورد بررسی شده است

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Fifth Annual Report

OF THE BOARD OF

Water Commissioners

— OF THE —

City of Los Angeles

California

FOR THE YEAR ENDING
NOVEMBER 30, 1906



29 1008

FIFTH ANNUAL REPORT

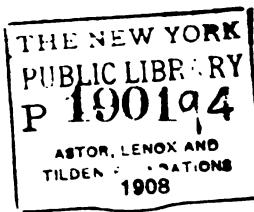
OF THE

BOARD OF WATER COMMISSIONERS

OF THE CITY OF LOS ANGELES

FOR THE YEAR ENDING
NOVEMBER 30, 1906

KINGSLEY, MOLES & COLLINS CO
Los Angeles, Cal

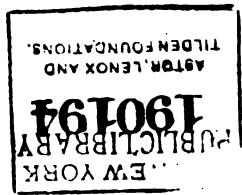


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BUENA VISTA RESERVOIR



BOARD OF WATER COMMISSIONERS

FRED L. BAKER
GEN'L M. H. SHERMAN
JNO. J. FAY, JR.
WM. MEAD
J. M. ELLIOTT

OFFICERS

JNO. J. FAY, JR., President
JAS. P. VROMAN, Secretary
WM. MULHOLLAND, Superintendent
L. M. ANDERSON, Auditor

Los Angeles, Cal., Dec. 17, 1906

To the Honorable City Council,
Of the City of Los Angeles.

Gentlemen:—In accordance with the Charter, we beg to submit herewith the Fifth Annual Report of the Board of Water Commissioners, being for the fiscal year ending November 30, 1906.

Concerning the Los Angeles Aqueduct and the acquisition of properties in Owens River Valley, in addition we report that the matter has been transferred to the Board of Public Works, which body, in compliance with the unofficial promise given by the members of this Board to the Citizens that a Board of Engineers of national reputation would consider the whole question, did appoint such Commission which is at present considering the matter in this City.

Respectfully,

JNO. J. FAY, JR., President.

J. M. ELLIOTT.

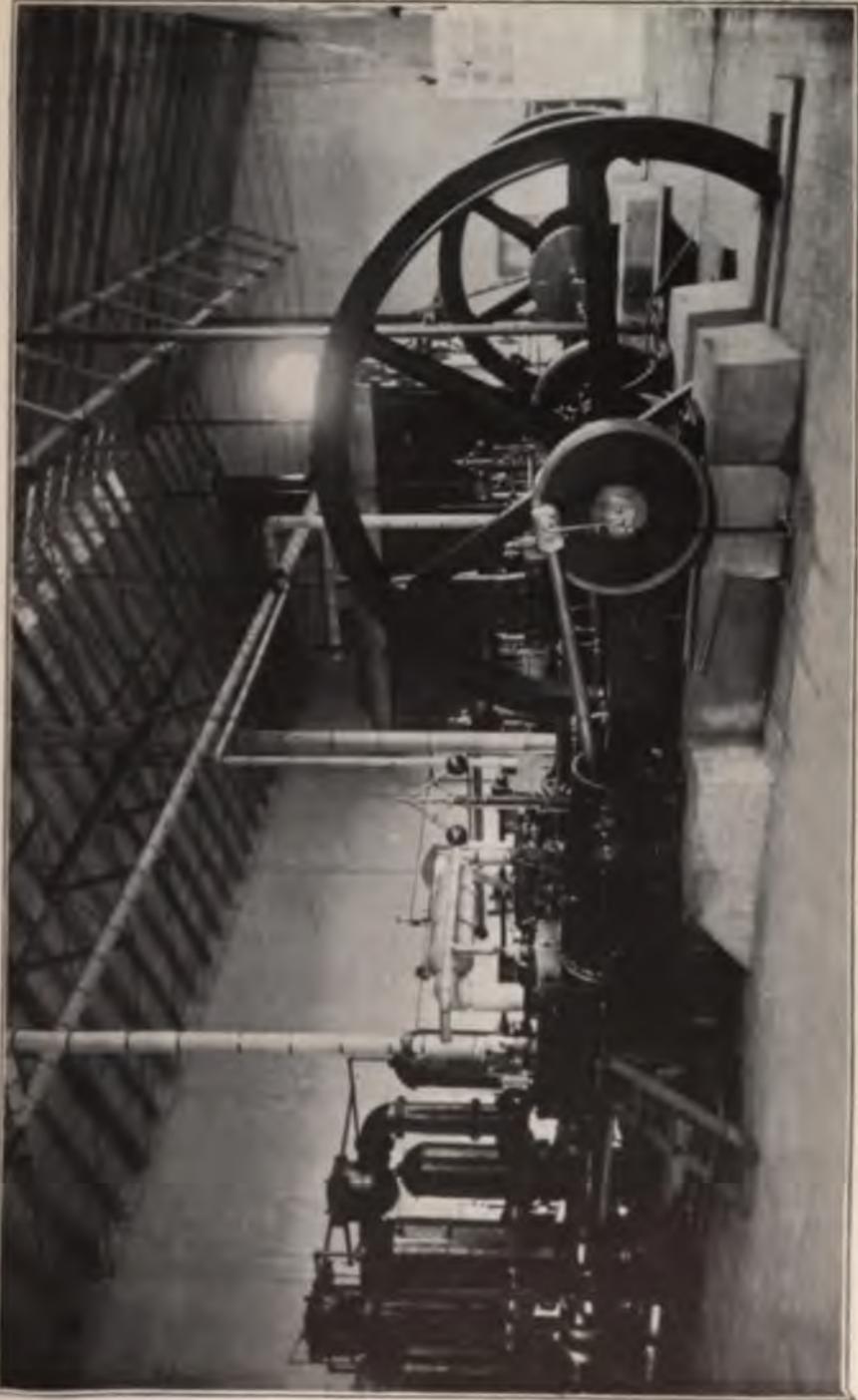
FRED L. BAKER.

WM. MEAD.

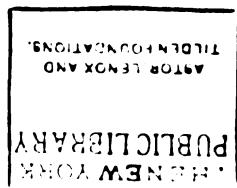
M. H. SHERMAN.

Board of Water Commissioners
of the City of Los Angeles.

1



SLAUSON AVENUE PUMPING PLANT



Superintendent's Report

For the year Ending November 30, 1906

To the Honorable Board of Water Commissioners,
Of the City of Los Angeles:

Gentlemen:—In submitting this, the Fifth Annual Report of the Engineering and Construction Department, it will scarcely be necessary to do more than refer to the account of the Auditor showing the expense for new construction to assure you of the continued activity in this branch of the Department.

The number of services sold and put in for the year was 5984, which lacks but 24 of the number sold last year, and is 839 in excess of the number sold in 1904.

The remarkable steadiness of this great rate of growth elicits the astonishment of Water Works officials all over the country, meaning, as it does, an added population of over 50 per cent. in three years.

Seven thousand, six hundred and eighty-eight tons of cast iron pipe, aggregating nearly 47 miles in length, were added to the distributing system during the year. About half of this mileage was used in enlarging and bettering the older portion of the system, improving not alone the service for ordinary needs of the City, but adding materially to our security from fire.

There were 230 new fire hydrants erected, and it is the intention to more than double this number in the coming year, as there was difficulty about securing hydrants as fast as they were needed that is now happily removed by our success in inducing home foundrymen to make them here instead of relying on Eastern factories, as we did in the past.

METERS.

Six thousand, nine-hundred-and-seventy-eight meters were set during the year, which raised the total number now in use to 15,810, which is about 31 percent of the active services in use as against 19.7 per cent. metered at the end of the last fiscal year.

The effect of the use of these meters is well shown by the fact that the mean consumption for the summer months was somewhat less than 36,000,000 gallons per day, while that for last year was about 34,000,000 gallons, the latter figure representing a per capita consumption of 151 gallons, while the figures for this year show but 144 gallons.

This rate of consumption is in marked contrast with that of 1902, when the per capita rate was over 300 gallons. At that time there were practically no meters used, and it was predicted by many that their use would tend to destroy the City's beauty by rendering the growth of lawns impractical on account of the expense of irrigating. This, happily, has not been found in practice to be true. In any event, even if it were, the growing scarcity of water to meet the demands of the rapidly increasing population required a more careful use of the failing supply.

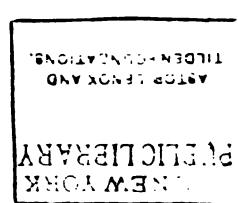
WATER SUPPLY.

Notwithstanding two years in succession of abundant rainfall, the Los Angeles River still shows a slight decline from that of the previous year, the mean flow for 1905 being 46.85 second feet, while for the present year it was but 45.53 second feet.

It will be remembered that in addition to the heavy rainfall of the last two years, the average for the last five years has been fully up to the mean rainfall during the nearly 30 years of observation at this point by the Government Weather Bureau. What, then, is the cause of the more than 40 per cent. deficiency in the flow of the stream, if it is not due to the heavy extraction of water for irrigation purposes from its source,—the gravel beds of the San Fernando Valley?



NEW MANHOE RESERVOIR



RESERVOIRS.

The reservoir at Ivanhoe, reported under construction in the last annual report, was completed and put in commission last May. This reservoir has a capacity of 50,000,000 gallons and served well during the summer to regulate the supply so as to meet erratic demands due to occasional heated terms.

The larger reservoir at Ivanhoe, for the construction of which a bond issue of \$150,000 was made two years ago, is now under construction, and it is expected we will be able to put some surplus water into it during the early spring months. This reservoir has been designated in the accounts of the Department as the "Silver Lake Reservoir." Its capacity, with the portion of the original site cut-off that was used for the Ivanhoe Reservoir above mentioned, is 767,000,000 gallons.

This great body of water will give a stability to our supply not alone by adding the amount of its contents, but in regulating the flow to enable the works to meet any unusual demand caused by extensive conflagrations or other disastrous occurrence.

The Infiltration Gallery at the Crystal Springs was begun last May and has been carried out a distance of about 2500 feet across the channel and flood plain of the river. The work was suspended on it at that point in October as the danger from floods would be great during winter time. It is now yielding about 4,000,000 gallons daily and will be carried on next year until it completely drains the surface flow of the river.

The pumping plant on the Pollock place was started early in the year, and was run during all the heated periods of the summer, yielding between 3,500,000 and 4,000,000 gallons of water. As we expected, this plant when run continuously night and day for over a month, somewhat diminishes the flow at the Narrows Gallery, but the distance is so great between the two that the flow of the gallery is not affected to an amount greater than possibly 30 or 40 per cent. of the water developed by the Pollock pumps; hence there is some gain accruing from its use.

The Department found it incumbent last summer to construct

a small pumping plant and erect a tank of 600,000 gallons capacity to serve the rapidly settling up high section lying west of Elysian Park and including the settlement of Edendale. The water to serve this district is now pumped from the Ivanhoe Reservoir main to elevation 735 feet above sea level, this region being too high to be served by the High Service Reservoir, which has a flow line elevation of but 613 feet above sea level.

The Works in general are in good condition and the pumping machinery is maintained at a high degree of efficiency. Naturally there are still many glaring defects in the Distributing System, due to our accelerated rate of growth, but which we are rapidly mending.

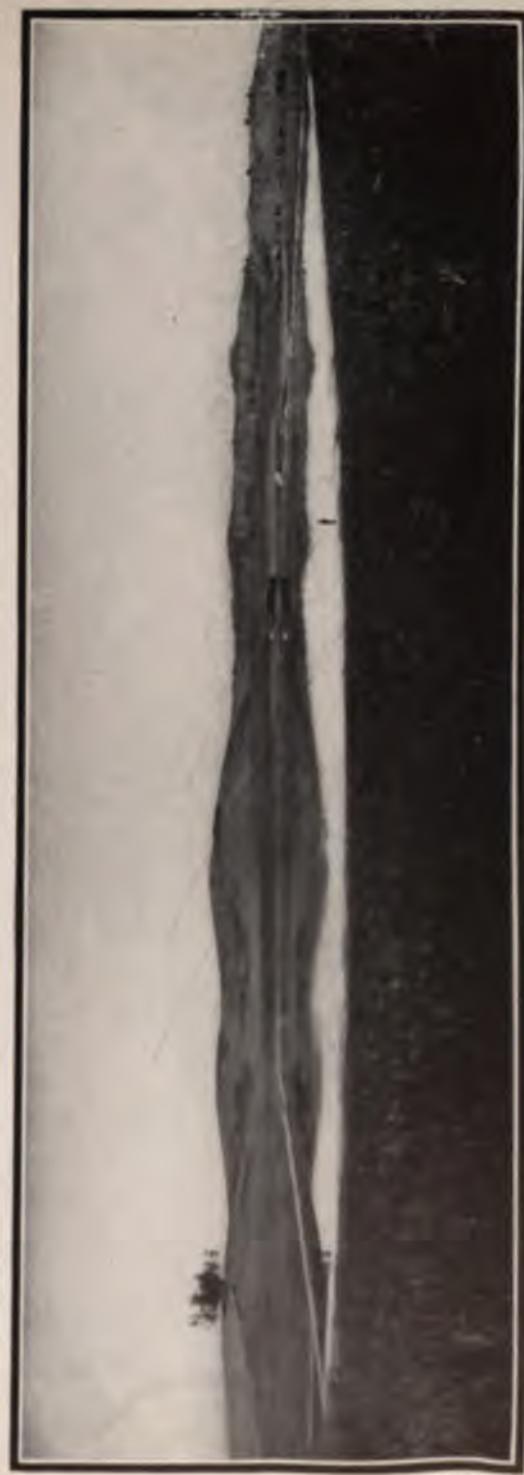
The following tables show in detail the additions made to the various features of the Works, during the year.

Thanking your Honorable Body for the many courtesies shown myself and co-laborers, I remain,

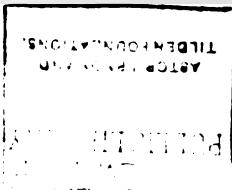
Yours respectfully,

WILLIAM MULHOLLAND,

Superintendent



IVANHOE RESERVOIR



**STATEMENT OF PIPE LAID DURING THE YEAR END-
ING NOVEMBER 15, 1906**

LOCATION	Size inches	Length feet
Third Street, Chicago to west of Mott.....	4	2129
Fifth Street, Alameda to Carolina.....	4	919
Sixth St., at Spring.....	4	20
Seventh St., bet. Wilton and Norton Pl.....	4	976
Eighth, Garland to Whittier.....	4	765
Ninth, bet. Gramercy and Garnier.....	4	310
Tenth, Stanford to Central.....	4	1499
Tenth at Central.....	4	20
Tenth at Olive.....	4	80
Tenth at San Pedro.....	4	65
Eleventh at Central.....	4	20
Eleventh, Stanford to Central.....	4	1519
Eleventh at Olive.....	4	56
Twelfth at Olive.....	4	80
Fourteenth at Central.....	4	22
Fifteenth, San Pedro to Griffith.....	4	1491
Fifteenth at San Pedro.....	4	25
Twentieth at Hermosa.....	4	80
Twentieth at Central.....	4	56
Twentieth, Central Ave. to east of Tivy.....	4	2358
Twenty-first at Hermosa.....	4	80
Twenty-second at San Pedro.....	4	23
Twenty-third, Normandie to west of Congress.....	4	1125
Twenty-fourth at San Pedro.....	4	23
Twenty-fourth, bet. Trinity & San Pedro.....	4	690
Twenty-fourth at Congress & West.....	4	319
Twenty-fifth at San Pedro.....	4	23
Twenty-fifth, Normandie to La Salle St.....	4	1675
Twenty-seventh at San Pedro.....	4	23
Twenty-seventh, bet. Trinity & San Pedro.....	4	640
Twenty-eighth, bet. Compton & Nevin.....	4	843
Twenty-ninth at Central.....	4	55
Thirtieth at San Pedro & West.....	4	23
Thirtieth, bet. San Pedro & Maple.....	4	1392
Thirty-first at San Pedro.....	4	23
Thirty-second at Central.....	4	55
Thirty-second, Maple to San Pedro.....	4	1415

LOCATION	Size inches	Length feet
Thirty-third, Central to Hooper.....	4	1331
Thirty-third at San Pedro.....	4	24
Thirty-fourth at Central.....	4	23
Thirty-fifth, Maple to San Pedro.....	4	1410
Thirty-sixth at Central.....	4	77
Thirty-seventh at Central.....	4	54
Thirty-seventh at Hooper.....	4	32
Thirty-seventh at Moneta.....	4	24
Thirty-seventh, bet. Hooper & Central.....	4	1245
Thirty-ninth, Normandie & East.....	4	63
Thirty-ninth, bet. East of Normandie & Vermont.....	4	2462
Thirty-ninth at Central.....	4	76
Fortieth, at Central.....	4	54
Forty-first at Central.....	4	76
Forty-second at Central.....	4	22
Forty-fourth, Normandie & East.....	4	403
Forty-fifth, Normandie to Budlong.....	4	1311
Forty-sixth, Vermont to Horticultural Ave.....	4	864
Forty-seventh, bet. Vermont & Normandie.....	4	2545
Forty-seventh, Normandie & East.....	4	42
Forty-eighth, East and west of Budlong.....	4	2540
Forty-ninth at Compton.....	4	15
Forty-ninth, South Park & East.....	4	88
Fifty-second at Central.....	4	22
Fifty-third at Main & East.....	4	60
Fifty-third, Central to Dominguez.....	4	643
Fifty-third, McKinley to Dominguez.....	4	624
Fifty-fourth, at Central.....	4	54
Fifty-fifth at Main & East.....	4	108
Fifty-fifth at Central.....	4	76
Fifty-sixth, East of McKinley.....	4	33
Fifty-seventh at Central.....	4	54
Fifty-eighth at Central.....	4	54
Ave. 20, Albion & South.....	4	307
Ave. 21, Pasadena Ave. to North of Humboldt.....	4	1644
Ave. 50, Monte Vista to Granada.....	4	934
Ave. 51, Monte Vista to Granada.....	4	933
Ave. 56, Monte Vista to West of Ash.....	4	856
Ave. 60, Pasadena Ave. to East of Monte Vista.....	4	924
Ave. 66, Pasadena Ave. to Thorne.....	4	615
Adams, at San Pedro.....	4	23
Agatha at San Pedro.....	4	65

LOCATION	Size inches	Length feet
Arapahoe, North & South of Pico.....	4	80
Allesandro, "F" St. to Baxter.....	4	370
Bouchet, Date to Clara.....	4	797
Baxter, Olympian to Preston.....	4	525
Berendo at Pico.....	4	77
Berendo at Eighth & North.....	4	277
Berendo at Wilshire.....	4	34
Berendo at Eighth & South.....	4	647
Bellevue Ave. at Casco & West.....	4	153
Breed, City View to Brooklyn.....	4	1692
Budlong Ave., North of Twenty-fourth.....	4	25
Budlong Ave., Forty-seventh to Forty-ninth.....	4	1107
Buena Vista, bet. Temple & Fort Moore Pl.....	4	576
Catalina, Pico to Sepulveda.....	4	675
Catalina at Pico.....	4	16
Catalina, Wilshire to Ninth.....	4	2069
Cahuenga at Pico.....	4	17
Carr, Hill to Main.....	4	711
Casco, Bellevue to London.....	4	364
Centennial at Temple.....	4	18
Central Ave., Fifty-eighth & South.....	4	231
Channing at Ninth.....	4	24
Chicago, Brooklyn to Bird.....	4	871
Clara, Macy to Bouchet.....	4	975
Congress, Twenty-first to Twenty-second.....	4	321
Colyton at Palmetto.....	4	24
Crocker at Twelfth & North.....	4	252
Crocker at Fifth.....	4	20
Crocker, Tenth to Twelfth.....	4	1197
Custer, Temple & North.....	4	542
Dewey Ave. at Pico.....	4	16
Douglass at Temple & South.....	4	798
Dorchester Ave. at Normandie.....	4	17
Downey Ave. at Pritchard & East.....	4	911
Eagle, Ave. 64 to Hamlet.....	4	1387
El Molino at Pico.....	4	16
Elwood at Ninth.....	4	23
Elden Ave., bet. Tenth & San Marino.....	4	577
Elden Ave. at Pico.....	4	24
Flower at Washington.....	4	24
Garnier, Ninth & San Marino.....	4	1241
Gladys Ave., Seventh to Agatha.....	4	803

LOCATION	Size inches	Length feet
Gramercy Pl. at Pico.....	4	20
Gramercy Pl., Ninth to Tenth.....	4	1711
Griffin Ave., at Ave. 28 & North.....	4	593
Hartford Ave. at Seventh.....	4	30
Harvard Boul., Pico & North.....	4	45
Helen, Carrillo & East.....	4	669
Hobart Boul., bet. Eleventh & Pico.....	4	1303
Ingraham, bet. Wilton & Norton Pl.....	4	847
Jasmine at Wilshire & North.....	4	132
Jasmine at Pico.....	4	78
Kensington Rd., Douglas to La Veta Place.....	4	1274
Kenwood Ave. at Twenty-ninth.....	4	45
King at Pico.....	4	17
Lake at Seventh.....	4	11
Lake, Eight to Eleventh.....	4	2161
Lambie, San Pablo to Soto.....	4	1531
Lamar, Main to Cardinal.....	4	1483
La Veta Terrace at Scott & South.....	4	870
La Veta Place, Kensington to Laguna.....	4	678
La Vita Place, Sunset to Laguna.....	4	276
Lemon at Ninth.....	4	74
Lee at Central.....	4	22
Long Beach Ave., Twenty-eighth to Thirty-eighth.....	4	1158
Magnolia Ave. at Pico.....	4	24
Manhattan Pl., Ninth to San Marino.....	4	1452
Merchant at Eighth & North.....	4	1240
Millard Ave. at Pico.....	4	56
Mission Rd. at Keith & East.....	4	108
Miami, Wilshire to Sixth.....	4	688
Newton at Tennessee & West.....	4	687
New Hampshire at Pico.....	4	17
New Hampshire at Wilshire.....	4	59
New Hampshire at Twelfth & South.....	4	644
Norton Place, bet. Seventh & Wilshire.....	4	638
Normandie Ave. at Pico.....	4	16
Normandie Ave. at Sixteenth.....	4	26
Ortega at Central.....	4	22
Pasadena Ave. at New York & South.....	4	536
Pasadena Ave. at Ave. 66.....	4	154
Pacific at Pico.....	4	56
Palmetto, Carolina to Colton.....	4	349
Piedmont Ave. at Ave. 61 & North.....	4	993

LOCATION	Size inches	Length feet
Raymond Ave. at Twenty-ninth.....	4	23
Reid at Pico.....	4	56
Roxbury Ave. at Normandie Ave.....	4	17
Santa Monica Ave. at Western Ave. & East.....	4	1138
San Pablo, Henry to Lambie.....	4	221
St. Andrews Pl., North & South of San Marino.....	4	1506
St. Andrews Pl. at Pico.....	4	20
Seaton at Vincent.....	4	21
South Park Ave., North & South of Forty-ninth.....	4	125
South Park Ave. at Fifty-first & North.....	4	62
Stewart at Seventh.....	4	30
Sunset Boul., Lucille to De Frees.....	4	752
Towne Ave. at Fifth.....	4	20
Trinity, Sixteenth to Twenty-first.....	4	1722
Van Ness Ave. at Pico.....	4	80
Vignes, First to Second.....	4	456
Warehouse Court, Alameda & East.....	4	460
Western Ave. at Santa Monica & North.....	4	621
Western Ave. at Pico.....	4	81
Whittier, Eighth to Ninth.....	4	392
Wilson at Ninth.....	4	74
Wilton Pl. at Pico.....	4	20
Wallace, bet. Helen & Douglas.....	4	296
Yale, College to Alpine.....	4	684
Total 4 inch laid to Nov. 15, 1906.....		95901

LOCATION	Size inches	Length feet
Twenty-fifth Street, Maple to San Pedro.....	5	1367
Total 5 inch pipe laid to Nov. 15, 1906.....		1367

LOCATION	Size inches	Length feet
Second, Main to Spring.....	6	338
Fourth, bet. Broadway & Hill.....	6	330
Fourth at Merrick & West.....	6	280
Fifth at Broadway.....	6	23
Fifth, Hill to Spring.....	6	803
Fifth at Olive & East.....	6	70
Fifth, Olive & Hill.....	6	241
Eighth, at Spring & West.....	6	272
Eleventh, Harvard to West of Caheunga.....	6	862
Twelfth at San Pedro.....	6	25
Twelfth at Irola.....	6	16
Twelfth at Central Ave.....	6	54
Twenty-third, Union to Vermont	6	2491
Twenty-ninth, East & West of Normandie.....	6	116
Twenty-ninth, Western to West of Normandie.....	6	2597
Twenty-ninth, Vermont to East of Normandie.....	6	2574
Thirty-second at Central.....	6	22
Thirty-eighth, Wesley to Hough.....	6	657
Thirty-eighth, Vermont to McClintonck.....	6	876
Fortieth at Central.....	6	22
Forty-seventh at Compton.....	6	15
Forty-seventh at Central.....	6	77
Fifty-first at Compton.....	6	23
Fifty-third at Compton.....	6	23
Amelia at Ducommun.....	6	74
Antonia, Main to Alhambra.....	6	1259
Budlong Ave. at Twenty-ninth.....	6	172
Dominguez, Thirtieth to Jefferson.....	6	665
Ducommun, Alameda to Vignes.....	6	1415
Evergreen Ave. at First.....	6	24
Hermosa, Washington to Adams.....	6	2638
Hobart B'l'v'd at Pico.....	6	63
Hobson at Pico.....	6	16
Hooper Ave., bet. Thirty-seventh & Thirty-eighth.....	6	332
Jefferson at Central.....	6	62
Lawrence at Ninth.....	6	75
Los Angeles, Ninth to Eleventh.....	6	1252
Long Beach Ave., Twenty-first to Twenty-fourth.....	6	664
Maryland, Lucas to Boylston.....	6	1235
Magnolia Ave. at Pico.....	6	50
Olive, Ninth to Eleventh.....	6	1836
Olive, Pico to North of Twelfth.....	6	673

BOARD OF WATER COMMISSIONERS

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LOCATION	Size inches	Length feet
Olive, bet. Sixth & Seventh.....	6	618
Paloma, Fourteenth to Washington.....	6	1835
Palmetto, Alameda to Colton.....	6	697
Quincy at Adams.....	6	42
Sunset Boul., Micheloreno to Maltman.....	6	922
Vincent, Alameda to Fourth.....	6	858
Wilshire Boul., Irola to Jasmine.....	6	210
Total 6 inch laid to Nov. 15, 1906.....		30494

LOCATION	Size inches	Length feet
First, Evergreen to Fresno.....	8	1250
Fourth, Clarence to Gless.....	8	302
Fourth, Fresno to Lorena.....	8	1355
Fourth, Estudillo to Lorena.....	8	1021
Fifth, Central to Wall.....	8	2142
Ninth at Olive	8	84
Eleventh at San Pedro.....	8	25
Boyle Ave., Sixth to North of St. Louis.....	8	1167
Clarence, Fourth to Sixth.....	8	1302
Estudillo, Fourth to Sixth.....	8	1280
Evergreen Ave., First to Brooklyn.....	8	1282
Figueroa at Jefferson.....	8	23
Figueroa, Jefferson to Thirty-seventh.....	8	929
Figueroa, Thirty-seventh to Thirty-ninth.....	8	853
Fresno, First to Fourth.....	8	1287
Main, Eighth to Ninth.....	8	1039
Main, Vernon to Fifty-fifth.....	8	4137
Main, Workman to Griffin.....	8	772
Normandie Ave., Santa Monica to Forty-sixth.....	8	946
Spring, bet. Eighth & Ninth.....	8	1008
State, Judson to Marengo.....	8	1421
Washington at Normandie.....	8	15
Total 8 inch laid to Nov. 15, 1906.....		23640

LOCATION	Size inches	Length feet
Fourth, from Fourth St. Bridge to Clarence.....	10	2829
Fourth, Santa Fe Ave. to Fourth St. Bridge.....	10	69
Thirty-seventh, bet. Main & Moneta.....	10	93
Brooklyn Ave., St. Louis to Evergreen.....	10	3794
Figueroa at Jefferson.....	10	62
Main, Thirty-sixth to Vernon.....	10	4858
Normandie Ave. at Jefferson.....	10	64
Normandie Ave., Jefferson to Santa Monica.....	10	2621
Pico at Irola & West.....	10	19
Pico, Western to Irolo.....	10	2403
San Pedro, Fifth to Seventh.....	10	1598
Santa Fe Ave., Stevenson to Fourth.....	10	423
Spring, bet' Sixth & Seventh.....	10	660
Total 10 inch laid to Nov. 15, 1906.....		19493

LOCATION	Size inches	Length feet
Seventh at San Pedro.....	12	9
Eleventh, Hoover to Bonnie Brae.....	12	1925
Eleventh, Bonnie Brae to Union.....	12	1375
Sixteenth at Central Ave.....	12	58
Sixteenth, Central to Alameda.....	12	3170
Adams, Hoover to Normandie.....	12	4993
Adams at San Pedro.....	12	90
Baxter, Olympian to 36 in. main.....	12	4086
Jefferson, Grand to Vermont.....	12	5110
Normandie Ave., Adams to Jefferson.....	12	2667
Olympian, Baxter to High Service Tank.....	12	1287
Pico, Normandie to Vermont.....	12	2669
Pico at Central.....	12	20
Pico, Hoover to Reid.....	12	2192
Pico at San Pedro.....	12	90
San Pedro, North of Seventeenth to Jefferson.....	12	5091
San Pedro, Seventh to South of Sixteenth.....	12	4423
Vermont Ave. at Wilshire.....	12	48
Vermont Ave. at Pico.....	12	78
Total 12 inch laid to Nov. 15, 1906.....		40281

BOARD OF WATER COMMISSIONERS

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LOCATION	Size inches	Length feet
Normandie Ave., Washington to Adams...	16	2623
Total 16 inch laid to Nov. 15, 1906.....		2623

LOCATION	Size inches	Length feet
Sixteenth, North & South of Normandie	18	148
Normandie Ave., Pico to Washington	18	2683
Washington at Normandie	18	153
Wilshire Boul., at Hoover	18	14
Total 18 inch laid to Nov. 15, 1906		2998

LOCATION	Size inches	Length feet
Irolo, Wilshire to Pico	20	5228
Pico, Irolo to Normandie	20	212
Reservoir (Ivanhoe) Inlet	20	100
Total 20 inch laid to Nov. 15, 1906		5540

FIFTH ANNUAL REPORT

LOCATION		Size inches	Length feet
Central Ave., North to Washington	.....	24	3426
Reservoir-Tranque Inlet	.....	24	100
Total 24 inch laid to Nov. 15, 1906.	.....		3526

LOCATION		Size inches	Length feet
Benton Blvd. - Wilshire to South	.....	30	681
Loring Ave. - East & West	.....	30	2912
Loring - Burnett to Glassell	.....	30	4360
Reservoir - Tranque Inlet	.....	30	140
Reservoir - Tranque - Bypass	.....	30	475
Wilshire Blvd. - Benton Blvd. to West of Catalina	.....	30	4106
Wilshire Blvd. - West of Catalina to Irda	.....	30	1288
Total 30 inch laid to Nov. 15, 1906.	.....		13942

LOCATION		Size inches	Length feet
Right of Way at Tranque Reservoir & N.W.	.....	36	9675
Total 36 inch laid to Nov. 15, 1906.	.....		9675

**SUMMARY OF PIPE LAID DURING THE YEAR
ENDING NOVEMBER 15, 1906**

4.	95901
5.	1367
6.	30494
8.	23640
10.	19493
12.	40281
16.	2623
18.	2998
20.	5540
24.	3526
30.	13962
36.	6675
Total.....	246500—46.68 miles

SERVICES BY WARDS

Ward	SIZE						Total	
	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	2	3	4	6
1st.....	580	51	3	4	3	-	-----	641
2d.....	485	56	6	-	5	-	-----	552
3d.....	64	72	19	4	6	-	-----	165
4th.....	224	165	34	7	2	-	-----	432
5th.....	1266	179	21	3	-	-	-----	1469
6th.....	1549	71	16	5	3	-	1 1	1646
7th.....	68	32	14	1	2	1	-	120
8th.....	29	3	3	2	-	-	1	38
9th.....	842	49	10	2	1	1	-	905
Total.....	5107	678	126	26	25	2	2 2	5968
Services sold and not put in for various reasons.....	-	-	-	-	-	-	16	-
							5984	
Services in system Nov. 15, 1906.....	-	-	-	-	-	-	46,166	-
Added during the year ending Nov. 15, 1906.....	-	-	-	-	-	-	5,984	-
Total Services.....	-	-	-	-	-	-	52,150	-

FIRE HYDRANTS

In system Nov. 15, 1905.....	1,083
Single Hydrants placed during year.....	195
Double Hydrants placed during year.....	35
Total Fire Hydrants in system Nov. 15, 1906.....	1,313

GATES

Placed during the year ending Nov. 15, 1906:

4 inch-----	259
5 " -----	1
6 " -----	114
8 " -----	32
10 " -----	21
12 " -----	35
16 " -----	3
18 " -----	3
20 " -----	2
24 " -----	1
30 " -----	4
36 " -----	1
Total-----	476

**TOTAL NUMBER OF METERS IN SERVICE
NOVEMBER 15, 1906****City and Private**

KIND	§ in.	§ in.	1 in.	1½ in.	2 in.	3 in.	4 in.	Total
Trident-----	7650	4270	269	12	7	4	0	12212
Nash-----	1394	27	1	64	13	1	0	1500
Lambert-----	402	303	96	0	9	2	0	812
Empire-----	174	21	263	145	20	25	11	659
Keystone-----	122	135	100	13	8	0	0	378
Crown-----	99	34	6	1	14	3	0	157
Hersey-----	38	4	9	0	2	0	0	53
Worthington-----	19	0	0	0	0	0	0	19
Columbia-----	20	0	0	0	0	0	0	20
Union Rotary-----	0	0	0	0	0	0	0	0
Totals in Sizes ..	9918	4794	744	235	73	35	11	15810
Number of Meters in use Nov. 15, 1905-----								8832
Number placed during the year ending Nov. 15, 1906-----								6978

NOTE: Of the above, 535 are owned by private parties.

Auditor's Report

For the Year Ending November 30, 1906

To the Honorable Board of Water Commissioners,
Of the City of Los Angeles,

Gentlemen:—I have the honor to herewith submit the 5th Annual Report of the financial operations of the Water Department for the year ending November 30, 1906.

The receipts, including amounts returned for advances on options, taxes, etc., were \$983,757.76, together with balance on hand Nov. 30, 1905 amounts to \$2,513,110.20. The disbursements for construction and betterment amount to \$697,042.68; for Operating and Maintenance, \$164,083.86; for Interest and Sinking Funds (including Owens River Bonds), \$278,353.75; Deposits returned, \$8,178.05; Furniture and fixtures, \$575.84, and on account of Land, etc. L. A. Aqueduct project, \$673,750.47, making a total expenditure of \$1,821,984.65.

The statements following will show more fully the sources of revenue and distribution of expenditures.

Respectfully submitted,

L. M. ANDERSON,

Auditor.

Balance by last report, Nov. 30, 1905		\$1,529,352.44
RECEIPTS		
Water Rates	\$870,193.25	
Water Permits	19,739.41	
Services	56,371.80	
Sundries, Labor & Material	5,015.13	
Rents	3,210.25	
Meters Sold	3,313.50	
Deposits, Extension St. Mains	10,261.00	\$968,104.34
Refunds on Land Acct.	15,368.67	
Refunds on Engineers' Exp.	175.75	
Refunds on Sundry Exp.	109.00	15,653.42
		983,757.76
	Forward	\$2,513,110.20

Brought Forward \$2,513,110.20

TOTAL DISBURSEMENT**Betterments**

Street Mains & Services	\$472,248.28
Meters	72,651.47
Machinery	6,354.16
Water Development	9,127.15
Ivanhoe Reservoir	30,183.55
Reservoirs	367.41
Head Works	1,277.74
Silver Lake Reservoir	45,819.88
Silver Lake Tunnel	2,127.09
Infiltration Gallery	209.35
Crystal Springs Gallery	39,169.83
Shop & Stables	216.87
Pollock Pumping Plant	872.61
Buena Vista Pumping Plant	169.50
Edendale Pumping Plant	3,923.19
Figueroa St. Plant & Land	5,520.95
Head Works Pumping Plant	83.60
Edendale Res. Tank	4,994.92
Land & Buildings	1,725.13 \$697,042.68
Operating & Maintenance	164,083.86
Transfer to Int. & Sink. Fund	278,353.75 442,437.61
Deposits Returned	8,178.05
Furniture & Fixtures	575.84
	\$1,148,234.18

LOS ANGELES AQUEDUCT ACCOUNT

Land	\$565,794.89
Engineering	77,830.03
Canal & Road	18,442.10
Interest Land Contracts	864.87
Water Investigation	5,085.14
Sundry Expenses	4,878.04
Cement Investigation	855.40 \$673,750.47 \$1,821,984.65
Balance with City Treasurer, Dec. 1, 1906	691,125.55
	\$2,513,110.20

CONDITION OF FUNDS DEC. 1, 1906

Water Revenue Fund	\$ 69,459.53
Water Works Bond 1905 Fund	580,893.83
WaterWorksBond1905 Fund (Res.)	40,772.19 \$691,125.55

INTEREST AND SINKING FUNDS

Water Works Bonds 1895	\$ 1,728.75
Water Works Bonds 1901	32,812.50
Water Works Bonds 1904	24,218.75
Water Works Bonds 1904 (Res.)	9,093.75
Water Works Bonds 1905 (OwensR.)	29,250.00 \$ 97,103.75

RECEIPTS BY MONTHS

DECEMBER 1905

Water, Rates	\$69,025.05
Water Permits	2,545.60
Services	5,012.00
Sundries, Labor & Material	34.05
Rents	818.75
Meters, Sold	278.00
Deposits, Extension Street Mains	640.00 <u>\$78,353.45</u>

JANUARY 1906

Water, Rates	\$68,650.05
Water, Permits	2,273.10
Services	4,995.00
Rent	118.00
Meters Sold	256.00
Deposits Extension Street Mains	1,208.80
Sundries, Labor & Material	497.20
Return on Wm. Penn Colony Contract	14,118.04
Return on S. H. Reynold's Option	200.00 <u>\$82,316.19</u>

BOARD OF WATER COMMISSIONERS

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FEBRUARY 1906

Water Rates	\$69,874.20
Water Permits	1,779.35
Services	1,386.00
Rents	198.00
Meters Sold	180.00
Deposits, Extension Street Mains	1,074.20
Sundries, Labor & Material	<u>341.75</u> \$77,833.50

MARCH 1906

Water Rates	\$68,865.58
Water Permits	1,757.00
Services	5,133.00
Rents	126.00
Meters	342.00
Deposits, Extension Street Mains	1,339.00
Sundries, Labor & Material	<u>581.01</u> \$78,143.62

APRIL 1906

Water Rates	\$70,313.00
Water Permits	1,322.00
Services	5,217.00
Rents	110.00
Meters Sold	335.00
Deposits	1,175.00
Sundries, Labor & Material	362.61
Cancelled Demand	<u>7.00</u> \$78,844.61

MAY 1906

Water Rates	\$70,435.20
Water Permits	1,501.15
Services	5,013.00
Rents	118.00
Meters Sold	237.00
Deposits, Extension Street Mains	700.00
Sundries, Labor & Material	817.10
Refund on Taxes	27.11
Refund on Express Charges	.50
Refund Surveyor General	<u>122.00</u> \$79,064.00

JUNE 1906

Water, Rates	\$64,731.88
Water, Permits	2,060.35
Services	4,922.30
Rents	954.50
Meters	316.00
Deposits, Extension Street Mains	834.00
Sundries, Labor & Material	41.20
S. P. Co., for Supplies lost	53.75
	<u>\$73,913.98</u>

JULY 1906

Water, Rates	\$74,908.30
Water, Permits	1,191.00
Services	4,698.00
Rents	125.00
Meters Sold	291.00
Deposits, Extension Street Mains	825.00
Sundries, Labor & Material	206.71
	<u>\$82,245.01</u>

AUGUST 1906

Water, Rates	\$79,259.95
Water, Permits	1,322.95
Services	4,578.00
Rents	141.00
Meters Sold	348.00
Deposits, Extension Street Mains	258.00
Sundries, Labor & Material	576.20
Refund Taxes	132.22
	<u>\$86,616.32</u>

SEPTEMBER 1906

Water, Rates	\$78,294.40
Water, Permits	956.55
Services	4,354.00
Rents	133.00
Meters Sold	185.50
Deposits	747.00
Sundries, Labor & Material	106.10
Return on Land Account	100.00
Return on Attorney's Expenses	109.00
	<u>\$84,985.55</u>

BOARD OF WATER COMMISSIONERS

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OCTOBER 1906

Water, Rates	\$80,013.99
Water, Permits	1,711.43
Services	1,514.00
Rents	125.00
Meters Sold	260.00
Deposits, Extension Street Mains	1,108.00
Sundries, Labor & Material	279.73
	<u>\$88,042.65</u>

NOVEMBER 1906

Water, Rates	\$75,821.65
Water, Permits	1,285.93
Services	3,519.00
Rent	243.00
Meters Sold	287.00
Deposits, Extension Street Mains	202.00
Sundries, Labor & Material	1,171.11
Cancelled Demand No. 13991, Land Account	783.77
	<u>\$83,401.76</u>

DISBURSEMENTS BY MONTHS

DECEMBER 1905

	Labor	Materials, etc.	Total
Construction, Street Mains	\$ 6,801.35	\$11,690.49	\$21,503.84
Machinery		.316.01	.316.01
Water Development	130.00	2,316.00	2,446.00
Ivanhoe Reservoir	6,079.03	7,390.88	13,469.91
Reservoirs		.321.33	.321.33
Head Works	176.50	106.28	282.78
Meters		10,368.50	10,368.50
Operating & Maintenance	10,111.78	1,657.15	11,768.93
Land		138,113.21	138,113.21
Engineering, L. A. Aqueduct	2,116.75	2,830.99	4,947.74
San Fernando Case	1,015.25		1,015.25
Deposits Returned		712.50	712.50
Interest		.864.87	.864.87
L. M. Anderson, Auditor		200.00	200.00
	\$28,869.06	17,160.21	\$46,029.27

JANUARY 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$ 6,207.40	\$ 7,840.37	\$14,047.77
" Machinery		23.90	23.90
" Water Development	1,220.25	125.00	1,345.25
" Ivanhoe Reservoir	5,194.20	288.63	5,482.83
" Head Works	62.00	2.52	64.52
Meters		5,935.10	5,935.10
Operating & Maintenance	9,849.75	1,967.16	11,816.91
Land		2,500.08	2,500.08
Water Investigation		257.52	257.52
Engineering, L. A. Aqueduct	1,511.00	1,356.22	2,867.22
San Fernando Case	1,813.40	204.00	2,017.40
Deposits Returned		408.50	408.50
	<hr/>	<hr/>	<hr/>
	\$25,858.00	\$20,909.00	\$46,767.00

FEBRUARY 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$ 9,540.68	\$26,657.52	\$36,198.20
" Machinery		495.00	495.00
" Water Development	848.75	776.59	1,625.34
" Ivanhoe Reservoir	4,486.50	23.15	4,509.65
" Reservoirs		13.68	13.68
Meters		5,348.70	5,348.70
Operating & Maintenance	10,141.85	1,796.41	11,938.26
Land		3,700.00	3,700.00
Water investigation	450.00	300.34	750.34
Engineering, L. A. Aqueduct	1,642.00	1,005.01	2,467.01
Canal	3,716.87	309.49	4,026.36
San Fernando Case	110.00		110.00
Deposits Returned		757.50	757.50
	<hr/>	<hr/>	<hr/>
	\$30,756.65	\$41,183.39	\$71,940.04

MARCH 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$11,687.23	\$73,011.81	\$84,699.04
" Machinery		5,519.25	5,519.25
" Water Development	451.50	39.40	490.90
" Ivanhoe Reservoir	3,915.70	35.01	3,950.71
" Reservoirs,		29.40	29.40
" Head Works	56.00	395.03	451.03
Meters		3,790.80	3,790.80
Operating & Maintenance	9,767.40	2,237.24	12,004.64
Land		2,240.00	2,240.00
Water Investigation	803.05	37.85	840.90
Engineering, L. A. Aqueduct	2,471.47	218.80	2,690.27
Canal, Aqueduct	1,910.12		1,910.12
San Fernando Case	40.00		40.00
Deposits Returned		743.60	743.60
	\$31,102.47	\$88,298.19	\$119,400.66

APRIL 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$11,511.62	\$39,619.12	\$51,130.74
" Ivanhoe Reservoir	5,136.85	77.13	5,213.98
" Head Works		19.41	19.41
" Pollock Pumping Plant	553.82	289.29	843.11
" Crystal Springs Gallery	372.50	66.22	438.72
" Buena Vista Pumping Plant		6.50	6.50
Meters		3,892.10	3,892.10
Operating & Maintenance	9,900.03	2,307.42	12,207.45
Land		20,435.00	20,435.00
Water Investigation	582.10	905.21	1,487.31
Engineering, L. A. Aqueduct	1,391.15	1,642.61	3,033.76
Canal, Aqueduct	2,285.05	28.00	2,313.05
San Fernando Case	40.00		40.00
Furniture & Fixtures		14.70	14.70
Deposits Returned		1,050.00	1,050.00
Int. Fund, Bond 1905		30,000.00	30,000.00
	\$31,773.12	\$100,352.71	\$132,125.83

MAY 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$14,903.47	\$62,636.90	\$77,540.37
" Services	27.00		27.00
" Water Department		71.40	71.40
" Ivanhoe Reservoir	1,228.85	1,471.87	2,700.72
" Shop & Stables	33.00	183.87	216.87
" Crystal Springs Gallery	3,115.80	1,163.16	4,278.96
" Buena Vista Pumping Plant		34.34	34.34
Meters	49.00	2,052.85	2,101.85
Operating & Maintenance	10,241.10	1,572.29	11,813.39
Land		5,729.73	5,729.73
Water Investigation	566.01	13.73	579.74
Engineering, L. A. Aqueduct	1,336.50	1,915.51	3,252.01
Canal, Aqueduct	1,840.25	71.92	1,912.17
Deposits Returned		353.75	353.75
Furniture & Fixtures		33.00	33.00
	\$33,340.98	\$77,304.32	\$110,645.30

JUNE 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$12,152.78	\$12,913.07	\$25,065.85
" Services	931.80	884.56	1,816.36
" Crystal Springs Gallery	3,223.15	1,886.32	5,109.47
" Edendale Plant	300.70	72.39	373.09
Meters	234.00	4,736.80	4,970.80
Operating & Maintenance	10,186.18	3,213.72	13,399.90
Land		5,505.01	5,505.01
Water Investigation	130.55		130.55
Engineering, L. A. Aqueduct	1,629.14	2,688.35	4,317.49
Canal, Aqueduct	1,218.00		1,218.00
Sundry Expenses, Aqueduct	465.54	12.90	478.44
Deposits Returned		591.00	591.00
Furniture & Fixtures		77.95	77.95
San Fernando Case	54.00		54.00
Ivanhoe Reservoir	104.65	654.22	758.87
	\$30,630.49	\$33,236.29	\$63,866.78

JULY 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$11,026.28	\$13,671.68	\$24,697.96
" Services	866.20	2,516.43	3,382.63
" Crystal Springs Gallery	3,531.90	3,407.03	6,938.93
" Infiltration Gallery		4.74	4.74
" Water Develop., Mach.		2,036.71	2,036.71
" Ivanhoe Reservoir		483.36	483.36
" Pollock Pumping Plant		29.50	29.50
" Buena Vista Pumping Plant		2.66	2.66
" Edendale Pump. Plant	1,020.65	1,125.23	2,145.88
Meters	966.95	5,536.00	6,502.95
Operating & Maintenance	10,459.25	3,124.03	13,583.28
Land		861.25	861.25
Water Investigation	160.90		160.90
Engineering, L. A. Aqueduct	2,824.81	1,681.42	4,506.23
Canal, Aqueduct	1,152.00		1,152.00
Sundry Expenses, Aqueduct	540.00	1,846.57	2,386.57
Deposits Returned		1,285.00	1,285.00
Furniture & Fixtures		1.25	1.25
	\$32,548.94	\$37,612.86	\$70,161.80

AUGUST 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$11,467.78	\$ 9,591.61	\$21,059.39
" Services	982.05	5,083.48	6,065.53
" Crystal Springs Gallery	5,093.70	3,949.66	9,043.36
" Infiltration Gallery		166.87	166.87
" Water Develop., Mach.		137.57	137.57
" Ivanhoe Reservoir		57.47	57.47
" BuenaVista Pumping Plant		126.00	126.00
" Edendale Pumping Plant	837.75	5,031.82	5,869.57
" Silver Lake Reservoir	3,155.25	117.71	3,272.96
Meters	1,070.30	7,484.12	8,554.42
Operating & Maintenance	11,284.85	4,293.89	15,578.74
Land, City		75.00	75.00
Land, Owens River		17,042.99	17,042.99
Water Investigation	122.20		122.20
Engineering, L. A. Aqueduct	5,383.35	2,757.43	8,140.78
Sundry Expenses, Aqueduct	200.00		200.00
Canal, Aqueduct	1,194.00	60.65	1,254.65
Furniture & Fixtures		150.33	150.33
Transfer to Int. & Sinking Fund		248,353.75	248,353.75
	\$40,791.23	\$304,480.35	\$345,271.58

FIFTH ANNUAL REPORT

SEPTEMBER 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$10,113.63	\$29,810.56	\$39,924.19
" Services	992.50	1,817.18	2,809.68
" Ivanhoe Reservoir		3.25	3.25
" Water Develop., Mach.	39.00	661.58	700.58
" Crystal Springs Gallery	3,578.60	3,862.77	7,441.37
" Infiltration Gallery		37.74	37.74
" Edendale Pumping Plant		529.57	529.57
" Silver Lake Reservoir	8,244.70	6,982.13	15,226.83
Meters	957.85	7,145.86	8,103.71
Operating & Maintenance	11,775.69	3,861.91	15,637.60
Land		34,540.50	34,540.50
Water Investigation	215.96		215.96
Engineering, L. A. Aqueduct	4,910.70	2,965.26	7,875.96
Canal, Aqueduct	724.00		724.00
Sundry Expenses, Aqueduct	600.00	184.88	784.88
Cement Investigation	350.00		350.00
Deposits Returned		383.00	383.00
Furniture & Fixtures		179.38	179.38
	\$42,502.63	\$92,965.57	\$135,468.20

OCTOBER 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$10,796.93	\$21,827.99	\$32,624.92
" Services	1,040.20	2,558.64	3,598.84
" Water Develop., Mach.		27.25	27.25
" Crystal Springs Gallery	2,207.75	991.70	3,199.45
" Silver Lake Reservoir	8,172.65	2,991.47	11,164.12
" Silver Lake Tunnel		223.45	223.45
" Figueroa Pumping Plant	20.00	5,330.00	5,350.00
Meters	862.15	4,711.50	5,573.65
Operating & Maintenance	10,978.60	3,595.81	14,574.41
Land		11,104.65	11,104.65
Water Investigation	250.00	52.35	302.35
Engineering, L. A. Aqueduct	7,867.73	6,814.76	14,682.49
Canal & Road, Aqueduct	2,007.65	13.25	2,020.90
Sundry Expenses, Aqueduct	377.50		377.50
Cement Investigations	250.00		250.00
Deposits Returned		1,105.00	1,105.00
Furniture & Fixtures		94.63	94.63
	\$44,631.16	\$61,442.45	\$106,273.61

NOVEMBER 1906

	Labor	Material, etc.	Total
Construction, Street Mains	\$10,203.83	\$11,263.71	\$21,467.54
" Services	1,114.20	3,474.23	4,588.43
" Ivanhoe Reservoir	204.10		204.10
" Water Develop., Mach.		240.15	240.15
" Crystal Springs Gallery	1,605.40	1,114.17	2,719.57
" Silver Lake Reservoir	7,767.85	8,388.12	16,155.97
" Silver Lake Tunnel	1,567.85	335.79	1,902.64
" Figueroa Pumping Plant	165.00	5.95	170.95
" Head Works Pump. Plant	83.60		83.60
Meters	860.75	6,648.14	7,509.89
Operating & Maintenance	11,540.00	2,943.40	14,483.40
Land		25,641.60	25,641.60
Engineering, L. A. Aqueduct	12,691.31	5,827.76	18,519.07
Water Investigation	70.00	167.37	237.37
Deposits Returned		788.20	788.20
Furniture & Fixtures		24.60	24.60
Canal & Road, L. A. Aqueduct	1,910.85		1,910.85
Sundry Expenses, Aqueduct	625.00	25.65	650.65
Cement Investigation, Aqueduct	250.00	5.40	255.40
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	\$50,659.74	\$66,894.24	\$117,553.98

TOTAL RECEIPTS

Feb. 4 to Nov. 30, 1902	\$ 456,317.83
Year ending Nov. 30, 1903	614,264.92
Year ending Nov. 30, 1904	772,978.32
Year ending Nov. 30, 1905	\$ 906,233.01
Year ending Nov. 30, 1905, Bonds	1,671,431.33
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Year ending Nov. 30, 1906	\$ 983,757.76
	\$5,404,983.17

TOTAL DISBURSEMENTS

Feb. 4 to Nov. 30, 1902	314,163.56
Year ending Nov. 30, 1903	733,493.13
Year ending Nov. 30, 1904	777,813.74
Year ending Nov. 30, 1905	1,066,402.54
Year ending Nov. 30, 1906	1,821,984.65
	<hr/>
Balance on hand Nov. 30, 1906.....	\$ 691,125.55

BONDS

	Year Issued	Rate	Original Amount	Outstanding
Water Works Improvement	1895	4½%	\$ 30,000.00	\$ 21,750.00
Water Works	1901	3½%	2,000,000.00	1,750,000.00
Water Works	1904	3½%	337,500.00	312,500.00
Water Works (Reservoir)	1904	3½%	150,000.00	142,500.00
Water Works (Owens River)	1905	4 %	1,500,000.00	1,462,500.00
			<hr/>	<hr/>
			\$4,017,500.00	\$3,689,250.00

NUMBER OF COLLECTIONS MADE DURING THE YEAR

	Rates	Services	Permits	Sundries	Totals
Dec.	1905.....	39,022	524	580	47
Jan.	1906.....	39,658	518	287	69
Feb.	1906.....	40,490	454	285	53
Mar.	1906.....	41,185	545	244	69
April	1906.....	41,460	549	256	54
May	1906.....	42,391	522	245	38
June	1906.....	42,056	507	264	53
July	1906.....	42,507	474	246	35
August	1906.....	42,549	471	103	70
Sept.	1906.....	42,593	450	233	64
Oct.	1906.....	44,821	463	291	98
Nov.	1906.....	43,594	359	228	121
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	502,326	5,836	3,262	771	512,195

FACE OF LEDGER DECEMBER 1, 1906

Water	\$3,321,696.08
Permits	71,044.99
Services	56,371.80
Sundry Receipts	5,015.13
Rent Receipts	7,412.50
City of Los Angeles	82,876.12
Zanjas	\$ 3,071.50
Water Works Bonds:	
1895	21,750.00
1901	1,750,000.00
1904	321,500.00
1904 (Reservoir)	142,500.00
1905 (Owens River)	1,462,500.00
Interest	443,121.03
Water Dev., Construction	32,744.82
Water Investigation	12,376.63
Funds, Bonds, 1905	580,893.83
Res. Bonds 1904	10,772.19
Water Revenue	69,459.53
Interest & Sinking, 1895	1,728.75
Interest & Sinking, 1901	32,812.50
Interest & Sinking, 1904	24,218.75
Interest & Sinking Res., 1904	9,093.75
Interest & Sinking, 1905	29,250.00
Engineering Exp., O. R. L.	82,130.10
Expenses San Fernando Case	12,511.20
Operating & Maintenance	503,965.63
Deposits	737.00
Deposits	11,662.70
Ivanhoe Reservoir	30,459.50
Reservoir Construction	83,880.92
Head Works Construction	[39,793.87]
Infiltration Gallery Con.	37,571.61
Conduit	154,997.11

Land & Buildings	26,127.49
Land & Buildings	801,138.14
Inspection Operating	13,779.00
Conduit Owens River Line	18,442.10
Philbeck Construction & Land	12,166.61
Crystal Springs Gal. Construction	39,169.83
O. & M. Slanson Plant	3,684.06
Buena Vista Plant Construction	69,882.83
Furniture & Fixtures	6,071.34
Services Construction	22,288.47
O. & M. Buena Vista Plant	9,849.04
Shop & Stables Construction & Land	41,932.11
O. & M. Garvanza Plant	763.54
Slanson Plant Construction & Land	60,296.10
Garvanza Plant Construction	2,200.00
Low Feliz Plant Construction	1,375.51
Ivanhoe Plant Construction	1,197.57
Edendale Plant Construction	8,918.11
Sundry Exp., O. R. L.	4,769.04
O. & M. Pollock Plant	2,070.55
Silver Lake Res. Construction	45,819.88
O. & M. Edendale Plant	449.68
O. & M. Burbank Plant	178.20
Cement Investigation	855.40
Meters	148,506.33
Silver Lake Tunnel	2,127.09
Figueroa St. Plant Construction & Land	5,520.95
Street Mains Construction	3,673,517.41
L. M. Anderson, Aud.	1,000.00
Head Works Plant Construction	83.60
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	\$7,249,067.22
	\$7,249,067.22

LAND INSIDE CITY

	Assessed Val.	Appraised Val.
East Side Springs, Mullaly's Addn.	\$ 1,000.00	\$ 2,000.00
Hazard Reservoir, Lots 1 & 2, Blk. 4, Florence Ter.	180.00	700.00
Hazard Reservoir, 2 acres	600.00	2,000.00
Victor Hts. Tr., Lots 133 to 144 Incl.	3,840.00	10,000.00
Beaudry Res. Site	3,500.00	7,000.00
Angeleno Res. Site, 1 acre	1,000.00	2,000.00
Lot 31½, Hunter's Highland View Tr., 8 acres	2,000.00	4,000.00
Lots 21, 22, 23, 24, Blk. 28, De Soto Hts. Tr.	600.00	1,500.00
Lot 45, Blk. 3, Augusta Hts. Tr.	80.00	200.00
Cor. Alameda & Marchessault Sts. (Old Office)	5,490.00	15,000.00
2.65 acres, bet. Buena Vista Tr. & Elysian Park	1,060.00	2,500.00
Bellevue Reservoir, 8 acres	4,000.00	10,000.00
Lots 6 to 12 Incl., Blk. "G" Lincolnian Hts. Tr.	1,400.00	4,200.00
Part of Lot 8, Blk. 33, H. S.	750.00	2,000.00
Highland Reservoir, 10.5 acres	10,500.00	15,000.00
Yards, Bound'd by Ross, Alameda, 2d & Stephenson	8,000.00	50,000.00
Reservoir No. 5, 24 acres	10,000.00	20,000.00
Solano Reservoir Site	1,100.00	2,200.00
Silver Lake Res. Site, Shepherd Lands	7,600.00	25,000.00
Slauson Ave. Pump, Sta. N. E. Cor. Compton Ave.	9,000.00	20,000.00
Figueroa Plant, Lots 1, 2, 3 ,12, 16, 21 McCarthy Tr., N. E. Cor. Figueroa & Slauson	1,680.00	5,400.00
	<hr/>	<hr/>
	\$73,380.00	\$200,700.00

LAND IN COUNTY

	Appraised Value
Portions of Lots 18, 19 & 21, Blk. 3, Ivanhoe	\$ 100.00
Ivanhoe Res. Site, Bd. by Clyde, Rowena, Maxwell & Ettrick st.	5,000.00
Lot 9, Blk. 1 & Lot 50, Blk. 3, Ivanhoe	500.00
Portion of Lot 21, Blk. 31, Ivanhoe	200.00
Land Bd. by Lick Tr. & Griffith Land & River, 43.62 acres	4,362.00
Lot 7, Blk. 81, Providencia & Scott Tr., 22.60 acres	2,260.00
Crystal Springs Land, 4.09 acres	800.00
In Rio, San Rafael, 32 acres	3,200.00
Darby Reservoir site, 9.052 acres	1,800.00
In Ro. San Rafael, Bd. South by Ro. Los Feliz, 23.15 acres	2,315.00
Pomeroy & Hooker Lands, 314.82 acres	31,482.00
Lands in Rancho Providencia, 285.00 acres	28,500.00
Lands in Rancho Providencia (West Side Purchase), 358 acres	35,800.00
High Service Reservoir, Garvanza, about 1.00 acres	1,000.00
Pollock Place, in Ro. Los Feliz, 9.50 acres	5,500.00
Reservoir No. 7, 110.00 acres	50,000.00
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	\$304,759.00
On account of Lands Purchased L. A. Aqueduct Project	\$801,138.14

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Sixth Annual Report

OF THE BOARD OF

Water Commissioners

— OF THE —

City of Los Angeles
California

FOR THE YEAR ENDING
NOVEMBER 30, 1907



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SIXTH ANNUAL REPORT
OF THE
BOARD OF
WATER COMMISSIONERS
OF THE CITY OF LOS ANGELES

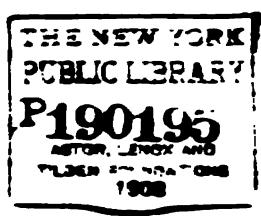
FOR THE YEAR ENDING NOVEMBER 30, 1907

BOARD OF WATER COMMISSIONERS

FRED L. BAKER M. H. SHERMAN JNO. J. FAY, JR.
JOHN R. MATHEWS JOHN H. NORTON

OFFICERS

JNO. J. FAY, JR., President
JAS. P. VROMAN, Secretary
WM. MULHOLLAND, Superintendent
L. M. ANDERSON, Auditor





BUENA VISTA RESERVOIR

1960
1961
1962
1963

Los Angeles, Cal., Dec. 17, 1907.

To the Honorable City Council,
Of the City of Los Angeles.

Gentlemen: Complying with the provisions of the Charter, we beg to submit herewith the Sixth Annual Report of the Board of Water Commissioners, for the fiscal year ending November 30, 1907.

Since the last report the personnel of the Board has been changed by the substitution of Messrs. John H. Norton and John R. Mathews for Messrs. J. M. Elliott and William Mead, whose terms expired.

The year has been one of great activity in construction work, and the largely increased revenue, together with addition of 3991 consumers, indicates the continued growth and prosperity of the city.

The work of the Department has, we believe, been carried on with its customary efficiency and economy in all branches. It was deemed proper during the last year to reduce the minimum rate on meters, with a view to equalizing the water tax burden with a just proportion to the small consumers. The revenue was not seriously affected by this adjustment, and great satisfaction was expressed by the beneficiaries of the change.

The Superintendent's report, which follows, outlines the work of improvement accomplished during the year, and the exhaustive report of the Superintendent of Meters will be found of interest in view of the fact that the city is now committed to a universal meter system, and the work is now far enough advanced to enable us to judge of the ultimate expense entailed in the adoption of this system.

The Auditor's report is very complete in detail and establishes the financial soundness of the Department.

Thanking your Honorable Body for your continued interest, we remain,

Respectfully

JNO. J. LAY, JR. President.

M. H. SHERMAN

JOHN H. NORTON

JOHN R. MATHEWS

FRED E. BAKER

Board of Water Commissioners
of the City of Los Angeles.

SUPERINTENDENT'S REPORT

For the Year Ending November 30, 1907

To the Honorable Board of Water Commissioners,
Of the City of Los Angeles.

Gentlemen:—The Annual Report herewith submitted is in many respects a substantial repetition of the last two or three, as far as the progress of enlarging and upbuilding the system is concerned, unusual activity having prevailed in every branch of the work as may be gathered from detailed tables hereto appended.

While it is true that the number of new taps for the year is considerably less than was put in last year, yet considered in connection with the generally superior class of buildings these taps serve, it is fairly certain that the gain for the year was the greatest in our history. This view is supported by the fact that the gain in revenue over the previous year was greater by nearly \$10,000 than the gain made for the year 1906, notwithstanding the reduction in the minimum meter rate made in February last, and which must have affected the revenue by at least \$10,000 additional.

There were 3991 new services put in, and 52.08 miles of cast iron pipe laid during the year, the aggregate weight of pipe being 4879 tons, in addition to which there was 592 tons of steel used in the force main for the new Figueroa Street Pumping Station.

As promised in the last Report, much attention was given to the improvement of the fire service, and great as have been our efforts in this direction, as shown by the addition of 446 fire hydrants for the year, much still remains to be done to properly safeguard the City. The commendable and necessary work requested by the Board of Fire Commissioners at the suggestion of Fire Chief Lips, viz: that of doubling the

number of fire hydrants in the congested business portions of the City, had to be deferred from lack of funds, but is now in process of being carried out. All of these new hydrants will be of the four inch double-nozzle type, and their prospective effectiveness was amply shown in a severely practical test made by the Fire Department a few months ago.

This test, which included among other trials, the supreme one of throwing eight one and one-eighth inch streams, aggregating 2200 gallons per minute, all drawn from one hydrant situated in the center of a block approximately 350 feet distant in either direction from any lateral connections into the main from which the water was drawn, with a drop in the pressure of less than twenty pounds shown on a gage attached to the barrel of the hydrant, shows that the liberal enlargement of the mains in the business section of the City and the increase in pressure created by connecting them with the High Gravity Reservoir, was highly effective in providing a dependable supply of water to meet any contingency.

Following this great result the proposition naturally suggests itself that we should make every effort to accomplish the same end in all parts of the City by a general enlargement of the mains, but strangely enough our inability to do this at an even reasonably early date is largely due to the great perfection of the City's transportation facilities, the effect of which is to expand the area occupied by the City's population.

It is doubtful if there is a city in the United States, or indeed in any country that requires as great a mileage of pipe per capita to serve her people with water, gas, or an adequate sewer system, as does Los Angeles. The total length of distributing mains in use November 15th of the present year was 639.86 miles.

The Department experienced great trouble during the past year by the growth of algae as well as larva and molluscan growth in both the Bellevue and Ivanhoe Reservoirs, necessitating the hasty construction of roofs over each of them. The Bellevue Reservoir had a roof built on wooden posts, that were erected in 1896, but owing to the rotting of the supports it partly collapsed last winter, and had to be wholly removed.

The greater portion of the lumber, however, was saved in good condition, and is being used again in the new structure.

The roof on the Ivanhoe Reservoir was completed in November. Both of these roofs are carried on reinforced concrete posts and girders, the type of construction being clearly illustrated in the photographic view shown in this Report.

Naturally the subject of greatest interest in connection with this Report, not alone to your Honorable Body, but to our citizens generally, is that of the water supply. This must be particularly the case in view of the fact that the subject was very thoroughly threshed out pro and con in the recent campaign in the Owens River Bond election, and the main facts must still be fresh in the minds of the people. About the most engrossing question to every thoughtful citizen must be: "Will the water supply continue in sufficient abundance as not to curtail the City's growth until the Owens River supply is brought here?"

Succeeding the remarkable series of dry years that ended with the season of 1903-04, we have had three successive winters with the rainfall decidedly above the mean, the average for the three being about 20 per cent above the mean annual precipitation for the last thirty years.

The effect of this increase on the flow of the Los Angeles River, while disappointing, still gives some hope that with a fair rainfall for the four or five years necessary to complete the great work before us the City will not materially suffer, although under any circumstances it will in the meantime, require extraordinary expenditures for development work of a temporary character to eke out our failing supply.

As illustrating the slow effect of the replenishment of the River due to the last three wet seasons, the mean stream flow of the River at the usual point of measurement near the Crystal Springs gate house was as follows:

The summer of 1904	42.73 second feet
1905	46.85 second feet
1906	45.33 second feet
1907	57.33 second feet

The mean flow of the River at this point for a period of 12 or 15 years preceding 1900 was from 70 to 75 second feet. So it will be seen that there was still a great deficiency last year in the normal flow, notwithstanding the marked increase from that of 1906.

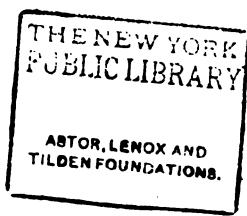
It is certain the rainfall on the mountain shed tributary to the Los Angeles River was greater last winter, relative to the valley precipitation than usual. The Tejunga Canon, which is the principal and by far the largest tributary of the Los Angeles River, poured out on its gravelly delta above Roscoe enormous volumes quite late into the summer, and at times in the early spring months maintained a continuous surface flow to within a mile or so of the River. This is an extremely unusual condition, as in the writer's knowledge extending over a period of thirty years, this never has occurred to such an extent before.

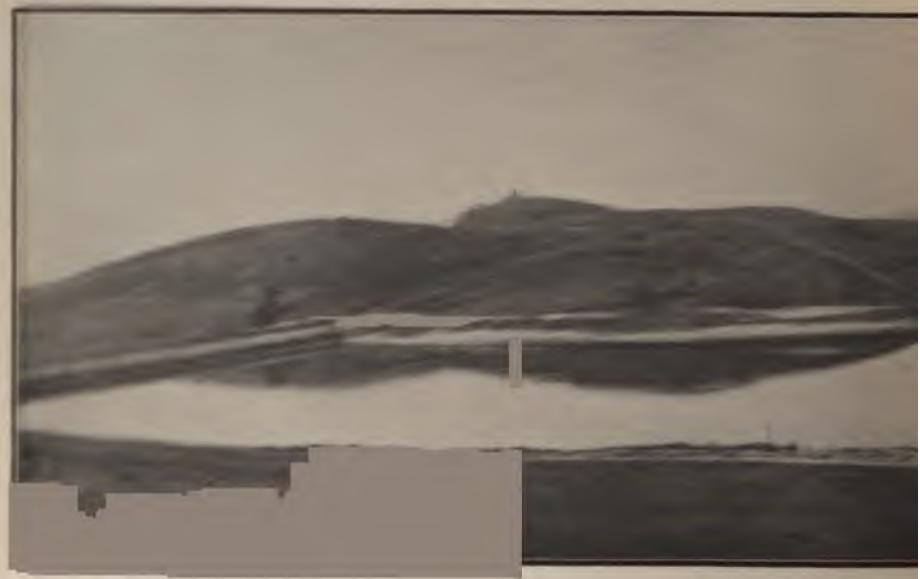
It is to be hoped that the River, following such a remarkable season, will continue to gain in volume for some time.

It has been deemed expedient by your Honorable Body, however, to take no chances in this matter, and to that end, acting under your instructions the extensive pumping plant consisting of wells, air compressor and seven million gallon pumping engine was installed at the corner of Figueroa Street and Slauson Avenue. This equipment is now completed, and when tested yielded in excess of four million gallons per day, with an opportunity to still further increase its output by possibly two million gallons more.

Owing to the increased flow in the River last year, it was not found necessary to use this plant, but it will, without doubt, prove a valuable reserve for the future.

This and the other plant two miles farther east on Slauson and Compton Avenues, working together, not alone assure us of a larger additional supply of water, but obviates the immediate very large construction expense for increased mains in the whole southern portion of the City. The decline in the level of the water plane in the region of these two plants has not been quite so rapid in the past two years as formerly.





SILVER LAKE RESERVOIR



ROOFING IVANHOE RESERVOIR-800



CAPACITY 773,000,000 GALLONS



750,000 cu. yds. OF CONCRETE AND 750,000 FT. OF LUMBER USED

Board of Water Commissioners

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In addition to this new water storage, the construction of the Silver Lake Reservoir will give us an additional acre of water storage a day for about 140 days and there is no expense involved in that so we will be in a position to take care of our supply at least for the coming year.

It is my opinion that the storage water in the reservoir will be used to supplement the water supply from the wells and not to replace it entirely. I think that we will have to depend on the wells for most of our water supply.

The new water system will be a great improvement over the old one. It will be more reliable and will provide a better supply of water for the town.

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**STATEMENT OF PIPE LAID DURING THE YEAR ENDING
NOVEMBER 15, 1907**

Location—	Size, inches.	Length, feet.
First St., at Beaudry Ave. and East.....	4	413
First St., Rampart to Andrews Blvd.....	4	615
First St., Olive to West line Beaudry.....	4	930
First St., Figueroa to Fremont St.....	4	415
Third St., Gless to Pecan St.....	4	363
Third St., Clarence to Gless.....	4	298
Fifth St., at Hope St.....	4	38
Sixth St., at Euclid Ave. and East.....	4	369
Sixth St., Clarence to Gless St.....	4	264
Sixth St., East of Euclid St.....	4	488
Sixth St., at Ezra St. and West.....	4	227
Eighth St., at Golden Ave. and West.....	4	58
Twentieth St., at Compton Ave.....	4	18
Twentieth St., at Union Ave.....	4	60
Twenty-first St., at Union Ave.....	4	18
Twenty-first St., Vermont to Budlong Ave.....	4	1405
Twenty-first St., at Compton Ave. and West.....	4	188
Twenty-first St., at Long Beach Ave. and East.....	4	940
Twenty-second St., Trinity to San Pedro St.....	4	695
Twenty-second St., at Union Ave.....	4	60
Twenty-second St., at Compton Ave. and West.....	4	206
Twenty-second St., at Long Beach Ave. and East.....	4	833
Twenty-second St., at Compton Ave. and West.....	4	218
Twenty-fourth St., west of Congress St.....	4	274
Twenty-fourth St., Vermont to Juliet St.....	4	1148
Twenty-fifth St., Naomi to Hooper Ave.....	4	832
Twenty-seventh St., at Vermont Ave.....	4	20
Twenty-eighth St., Vermont to Budlong Ave.....	4	1310
Thirty St., Budlong Ave. to Kansas	4	661
Thirty St., at Compton Ave. and East.....	4	1189
Thirty-first St., at Vermont Ave.....	4	21
Thirty-first St., at Thirty second St. and West.....	4	79
Thirty-first St., at Griffith Ave. and East.....	4	781
Thirty-sixth St., at Vermont Ave. and East.....	4	63
Thirty-sixth St., Wesley Ave. to Figueroa St.....	4	1113
Thirty-sixth St., East of Vermont Ave.....	4	268

Location--	Size, inch.	Length, feet.
Thirty-sixth St., Hough to West of McClintock	4	1502
Thirty-sixth St., Central to Hooper Ave.	4	1274
Thirty-seventh St., Normandie to Western Ave.	4	2624
Thirty-seventh St., at Vermont Ave.	4	20
Thirty-eighth St., Main to Woodlawn Ave	4	366
Thirty-ninth Street, Main to Woodlawn Ave	4	368
Thirty-ninth Street, Vermont to McClintock St	4	690
Fortieth St., Vermont to East of McClintock St	4	1040
Fortieth St., at Hough Ave. and West	4	117
Forty-first St., Vermont to Hough St.	4	991
Forty-fifth St., Main to Moneta Ave	4	1320
Forty-seventh St., Central to Compton Ave.	4	2566
Forty-seventh St., at Vermont Ave	4	26
Forty-eighth St., at Figueroa St.	4	27
Forty-eighth St., at Normandie Ave. and East	4	47
Forty-eighth St., at Vermont Ave	4	28
Forty-ninth St., East and West of Budlong Ave	4	2539
Forty-ninth St., at Normandie and East	4	48
Forty-ninth St., Central Ave. to Hooper Ave	4	1323
Forty-ninth St., at Vermont Ave	4	23
Fiftieth St., at Compton Ave. and East	4	870
Fifty-second St., at Figueroa St.	4	32
Fifty-fourth St., South Park to McKinley Ave	4	1332
Fifty-fifth St., Central Ave. to Compton Ave	4	2781
Fifty-eighth St., at Figueroa St.	4	27
Ave. 28, Pasadena to Workman St	4	82
Ave. 54, East and West of Alabama	4	37
Alabama St., at New York	4	26
Alabama St., Ave. 57 to W. of Ave. 54	4	1891
Albany St., at Ninth St	4	25
Andrews Blvd., First to N. of Sixth St	4	1766
Bixel St., at Seventh and South	4	476
Blaine St., at Ninth St	4	23
Bonnie Brae St., Sixteenth to Washington St	4	1274
Boylston St., Temple to S. of Magnonette St	4	644
Bond St., at Fourteenth and North	4	643
Britannia St., at Brooklyn Ave. and N	4	175
Broadway, bet California and Temple Sts	4	145
Bunkerhill Ave., at Alpine and North	4	419
Clover St., at Main St	4	24
Coronado St., at Temple and South	4	118
Daly St., at Main St	4	56

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<i>Location—</i>	<i>Size, inches.</i>	<i>Length, feet.</i>
Dalton St., at Twenty-ninth and North.....	4	87
Dalton St., North and South of Thirtieth.....	4	730
Dunn St., at Vermont Ave.....	4	29
Dewey St., at Pico St.....	4	62
Denver St., at Ninth St. and South.....	4	1395
Eastlake Ave., at Main St.....	4	56
Ellendale Ave., at Adams and South.....	4	923
Ellendale Ave., at Twenty-ninth and North.....	4	678
Essex St., Fourteenth to Washington St.....	4	1823
Ezra St., Fourth to Sixth St.....	4	1271
Figueroa St., at First and South.....	4	44
Flower St., at Adams St.....	4	55
Francisco St., at Ninth St.....	4	24
Francisco St., Eighth to Potter Park Ave.....	4	235
Gannah St., at Houston and North	4	203
Georgin St., at Ninth St.....	4	24
Girard St., Union to Bentous St.....	4	1795
Girard St., at Bonnie Brue and East.....	4	1135
Gibbons St., at Main St.....	4	24
Gless St., at Sixth St. and North.....	4	269
Golden St., at Ninth St.....	4	56
Gramercy Place, North of Pico.....	4	351
Gramercy Place, at Washington and North.....	4	51
Gramercy Place, Vernon to South of Forty-eighth St.....	4	2537
Green Ave., at Ninth St.....	4	47
Hancock St., at Main St.....	4	80
Harvard Blvd., at Wilshire Blvd. and South.....	4	1486
Halldale St., Adams St. to South of Twenty-ninth St.....	4	1657
Hendlock St., Ninth to Twelfth St.....	4	702
Henderson St., at Temple and South.....	4	1236
Hope St., at Adams St.	4	55
Hope St., at Fourth and North.....	4	262
Jasmine St., Wilshire Blvd. to San Marino St.....	4	2584
Johnston St., at Main St.....	4	24
Juliet St., Twenty-second to Adams St.....	4	1302
King St., Wilshire to San Marino St.....	4	2582
Lorena St., Fourth to Stephenson St.....	4	2551
Long Beach Ave., Twentieth to Twenty-first St.....	4	342
Maple Ave., at Sixth and South.....	4	106
Malvern Ave., Sixteenth to Alvarado Terrace.....	4	702
McKinley Ave., Fifty-fourth East to Fifty-fourth West... McKinley Ave., Forty-sixth East to Forty-sixth West.....	4	30 61

Board of Water Commissioners

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Location—	Size, inches.	Length, feet.
Thirty-sixth St., Hough to West of McClintock.....	4	1502
Thirty-sixth St., Central to Hooper Ave.....	4	1274
Thirty-seventh St., Normandie to Western Ave.....	4	2624
Thirty-seventh St., at Vermont Ave.....	4	20
Thirty-eighth St., Main to Woodlawn Ave.....	4	366
Thirty-ninth Street, Main to Woodlawn Ave.....	4	368
Thirty-ninth Street, Vermont to McClintock St.....	4	690
Fortieth St., Vermont to East of McClintock St.....	4	1040
Fortieth St., at Hough Ave. and West.....	4	117
Forty-first St., Vermont to Hough St.....	4	991
Forty-fifth St., Main to Moneta Ave.....	4	1320
Forty-seventh St., Central to Compton Ave.....	4	2566
Forty-seventh St., at Vermont Ave.....	4	26
Forty-eighth St., at Figueroa St.....	4	27
Forty-eighth St., at Normandie Ave. and East.....	4	47
Forty-eighth St., at Vermont Ave.....	4	28
Forty-ninth St., East and West of Budlong Ave.....	4	2539
Forty-ninth St., at Normandie and East.....	4	48
Forty-ninth St., Central Ave. to Hooper Ave.....	4	1323
Forty-ninth St., at Vermont Ave.....	4	23
Fiftieth St., at Compton Ave. and East.....	4	870
Fifty-second St., at Figueroa St.....	4	32
Fifty-fourth St., South Park to McKinley Ave.....	4	1332
Fifty-fifth St., Central Ave. to Compton Ave.....	4	2581
Fifty-eighth St., at Figueroa St.....	4	27
Ave. 28, Pasadena to Workman St.....	4	82
Ave. 54, East and West of Aldama.....	4	57
Aldama St., at New York	4	26
Aldama St., Ave. 57 to W. of Ave. 54.....	4	1801
Albany St., at Ninth St.....	4	23
Andrews Blvd., First to N. of Sixth St.....	4	2766
Bixel St., at Seventh and South.....	4	376
Blaine St., at Ninth St.....	4	23
Bonnie Brae St., Sixteenth to Washington St.....	4	1273
Boylston St., Temple to S. of Mignonette St.....	4	631
Bond St., at Fourteenth and North.....	4	633
Brittania St., at Brooklyn Ave. and N.....	4	1075
Broadway, bet. California and Temple Sts.....	4	145
Bunkerhill Ave., at Alpine and North.....	4	419
Clover St., at Main St.....	4	24
Coronado St., at Temple and South.....	4	1218
Daly St., at Main St.....	4	56

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Location—	Size, inches.	Length, feet.
First St., Hoover to Commonwealth St.....	6	452
Second St., at San Pedro and West.....	6	312
Third St., Commonwealth North to same South.....	6	53
Fourth St., Gless to Pecan St.....	6	304
Fourth St., Euclid to Fresno St.....	6	907
Fourth St., at Grand Ave.....	6	56
Fifth St., Alameda to Colyton St.....	6	587
Sixth St., at Maple Ave. and East.....	6	49
Sixth St., at Clarence St.	6	23
Eighth St., Figueroa to Golden St.....	6	1710
Tenth St., Figueroa to Broadway.....	6	2478
Twelfth St., Figueroa to San Pedro St.....	6	4974
Eighteenth St., Hoover to Bonnie Brae St.....	6	393
Twenty-first St., Compton to Long Beach.....	6	554
Twenty-first St., at Union Ave.	6	42
Twenty-second St., at Toberman and West.....	6	577
Twenty-second St., Compton to Long Beach Ave.....	6	905
Thirty-first St., at Vermont Ave.....	6	60
Thirty-first St., at Vermont Ave.....	6	59
Thirty-second St., Griffith to Central Ave.....	6	1210
Thirty-third St., Hooper to Compton Ave.....	6	1088
Thirty-seventh St., at Vermont Ave.....	6	68
Thirty-eighth St., Figueroa to Grand Ave.....	6	1334
Thirty-eighth St., at Wesley and East.....	6	1131
Fortieth St., at Vermont Ave.....	6	24
Forty-first St., South Park to Central Ave.....	6	2649
Forty-second St., at Vermont Ave.....	6	24
Forty-sixth St., South Park to Central Ave.....	6	2634
Fifty-third St., Main to Figueroa St.....	6	2624
Fifty-third St., at Figueroa St.....	6	24
Fifty-third St., Central to Compton Ave.....	6	2557
Fifty-sixth St., at San Pedro St. and West.....	6	459
Fifty-sixth St., East and West of Main St.....	6	1634
Fifty-sixth St., Figueroa to East of Moneta Ave.....	6	1735
Ave. 33, Pasadena to Andrew St.....	6	895
Alpine St., at San Fernando St.....	6	15
Apablaza St., Alameda to East of Juan St.....	6	604
Arnold St., Bixel to Baylston St.....	6	660
Banning St., Alameda to Vignes St.....	6	1306
Bellevue Ave., Belmont to Westlake Ave.....	6	943

Location—	Size, inches.	Length, feet.
Mallard St., at Eighth St.....	4	19
Menlo Ave., Adams to Twenty-ninth.....	4	1601
Mesquit St., at Seventh St.....	4	56
Morton Ave., at Echo Park Road and East.....	4	1280
Newton St., at Long Beach Ave. and West.....	4	295
Newton St., at Tennessee and at Long Beach and East.....	4	1058
Ohio St., First to Second St.....	4	384
Park Grove Ave., at Adams St.....	4	50
Pecan St., First to Fourth St.....	4	1639
Portland St., at Adams St.....	4	23
Potter Park Ave., Figueroa to Francisco St.....	4	529
Rampart St., Temple to North of Sixth St.....	4	4051
Rich St., at Fourteenth and North.....	4	633
Romeo St., Twenty-second to Adams St.....	4	1307
Ruth Ave., at Fourth St.....	4	24
San Julian St., bet. Thirty-seventh and Thirty-ninth Sts....	4	808
San Pedro St., Fifty-fifth to Fifty-sixth St.....	4	325
San Benito St., at Brooklyn and North.....	4	1083
St. Andrew's Place, North of Pico St.....	4	399
St. Andrew's Place, at Washington and North.....	4	50
Searff St., at Adams St.....	4	59
Severance St., at Adams St.....	4	23
Sierra St., from North of Flora to Borel St.....	4	1171
State St., Fourth to Fifth St.....	4	621
Stuart St., at Ninth St.....	4	47
Summit Ave., Anderson to Pleasant St.....	4	1398
Thompson, at Adams St.....	4	59
Towne Ave., at Fourth St.....	4	24
Trenton St., Eleventh to Pico St.....	4	1144
Van Ness Ave., North of Pico St.....	4	395
Vernon Ave., Normandie to Gramercy Place.....	4	4125
Westlake Ave., Pico to Alvarado St.....	4	743
Wilton Place, at Washington and North.....	4	53
Wilton Place, North of Pico St.....	4	375
Wilton Place, at Sixteenth and South.....	4	95
Wilshire Blvd., East of Jasmine to Harvard Blvd.....	4	777
Winter St., Evergreen to Blades St.....	4	1233
Workman St., Downey to North of Ave. 26.....	4	1653
Workman St., at Ave. 28 and South.....	4	407
Total 4-inch laid to November 15th, 1907.....		108983

Location—	Size, inches.	Length, feet.
Pasadena Ave., at Ave. 33.....	6	78
Palomares St., Compton to Nevin St.....	6	781
Reservoir St., bet. Mohawk North and Mohawk South.....	6	84
Santa Fe Ave., Batte to Cheney St.....	6	737
Soto St., Brooklyn to Second St.....	6	1743
Temple St., at Broadway and East.....	6	71
Thorpe St., Main to West of Grand Ave.....	6	2022
Thorpe St., West of Grand to Figueroa St.....	6	618
Thorpe St., at Figueroa St.....	6	20
Toberman St., Twenty-first East to Twenty-first West.....	6	132
Utah St., First to Kearney St.....	6	832
Valencia St., at Ninth St.....	6	23
Winston St., at San Pedro St.....	6	29
Winston St., at Wall St. and West.....	6	529
Winston St., Main to Los Angeles St.....	6	391
Total 6-inch laid to November 15th, 1907.....		92306

Location—	Size, inches.	Length, feet.
Sentous St., at Pico St. and North.....	7	523

Location—	Size, inches.	Length, feet.
First St., Fanning to Hoover.....	8	2289
Third St., Clarence East to Clarence West.....	8	84
Fourth St., Hope to East of Bunkerhill Ave.....	8	253
Fourth St., at Grand Ave.....	8	24
Fifth St., at Maple Ave. and East.....	8	257
Seventh St., at Santa Fe and East.....	8	610
Eighth St., Figueroa to Broadway.....	8	2417
Eleventh St., at San Julian St. and East.....	8	352
Fourteenth St., West of San Julian St.	8	381
Twenty-first St., West of Main to Market Ave.....	8	698
Twenty-first St., at Santa Fe and West.....	8	75
Twenty-first St., Main to First and Los Angeles St.....	8	744
Twenty-third St., at First and George Ave.....	8	1112
Twenty-fourth St., at First and Cypress St.....	8	1152
Twenty-fifth St., at First and North.....	8	197
Azusa St., West of First to West of Hermosa St.....	8	1760

Location—	Size, inches.	Length, feet.
Broadway, Franklin to Temple St.....	6	530
Broadway, at California St. and South.....	6	157
Budlong Ave., Adams to South of Thirtieth St.....	6	2149
California St., Hill to Broadway.....	6	335
Center St., Alico to Macy St.....	6	1090
Ceres Ave., Fifth to Eighth St.....	6	2744
Cimarron St., Jefferson to Twenty-eighth St.....	6	1591
Commonwealth St., First to South of Third St.....	6	1139
Crocker St., Fourth to Fifth St.....	6	633
Durango St., Flint to Thirtieth St.....	6	310
Durango St., Twenty-seventh to Flint St.....	6	947
Eureka St., Jefferson to Fortieth St.....	6	2097
Euclid St., Stephenson to Venice St.....	6	1277
Franklin St., New High to Spring St.....	6	290
Grand Ave., First to Temple St.....	6	1179
Grand Ave., Sunset Blvd. to California St.....	6	798
Grand Ave., Thirty-eighth to Fortieth St.....	6	600
Hough St., Fortieth to Forty-first St.....	6	308
Hope St., at Sixth and North.....	6	306
Hope St., Fourth to Fifth St.....	6	587
Howard St., at Alico St.....	6	73
Hooper Ave., Thirty-third East to Thirty-third West.....	6	156
Hooper Ave., Thirty-sixth to Thirty-seventh St.....	6	365
Kearney St., Anderson to Utah St.....	6	667
Lasalle St., Adams to Jefferson St.....	6	2654
Lee St., South Park to Central Ave.....	6	2657
Los Angeles St., Eleventh to Seventeenth St.....	6	2764
Long Beach Ave., Fourteenth to Sixteenth St.....	6	1045
Long Beach Ave., at Twenty-second and South.....	6	109
Long Beach Ave., at Thirty-eighth to Vernon Ave.....	6	782
Maple Ave., Fifth to Sixth St.....	6	683
Maple Ave., Eighth to Ninth St.....	6	701
Main St., Ave. 21 to Moulton St.....	6	640
McKinley Ave., Lee North to Lee St. South.....	6	37
Mesquit St., at Seventh St. and North.....	6	690
Mohawk St., South of Angelica to Sunset Blvd.....	6	2010
Naomi Ave., Sixteenth to Adams St.....	6	3151
Normandie Ave., Vernon to Forty-ninth St.....	6	3044
Ocean View Ave., Alvarado to Park View Ave.....	6	1257
Olive St., First to Temple St.....	6	1134
Pasadena Ave., Ave. 26 to North of Ave. 29.....	6	1427
Pasadena Ave., North of Ave. 29 to Ave. 33.....	6	999

Location—	Size, inches.	Length, feet.
Eighth St., East of Alameda St.....	12	82
Ninth St., Broadway to Figueroa St.....	12	2486
Ninth St., Figueroa to Burlington St.....	12	4565
Adams St., Hoover to Main St.....	12	5226
San Pedro St., Seventh to Agatha St.....	12	237
Vermont Ave., Adams to Jefferson St.....	12	2597
Total 12-inch laid to November 15th, 1907.....		15,193

Location—	Size, inches.	Length, feet.
Figueroa St., Jefferson to Forty-seventh St.....	16	8055

Location—	Size, inches.	Length, feet.
Fifty-eighth St., at Figueroa St. and East.....	18	111
Figueroa St., from Forty-seventh to Fifty-eighth St.....	18	3839
Total 18-inch laid to November 15th, 1907.....		3950

**SUMMARY OF PIPE LAID DURING THE YEAR ENDING
NOVEMBER 15TH, 1907.**

4 inch.....	108,983
6 inch.....	92,306
7 inch.....	523
8 inch.....	29,426
10 inch.....	16,558
12 inch.....	15,193
16 inch.....	8,055
18 inch.....	3,950
Total	274,994 feet = 52.08 miles.

SERVICES BY WARDS.

From November 15th, 1906, to November 15th, 1907.

Ward.	Size, Inches.								Total.
	1 1/2	3 1/2	4	4 1/2	5	6	7	8	
First	413	31	6	2	6	1	5	1	652
Second	388	27	5		6	1			627
Third	30	62	13	1	7	3	1	5	152
Fourth	269	131	20		10	1		1	432
Fifth	824	106	32		1			1	964
Sixth	824	62	11	2	9	1	2		910
Seventh	52	7	3	1	2			1	70
Eighth	22	4	4		1				34
Ninth	153	24	3	1	1				182
	3275	454	127	7	49	5	4	10	5925
Services sold but not put in									68
									6991
Services in system November 15th, 1906									52,150
Sold during the year ending November 15th, 1907									6,991
Total services in system November 15th, 1907									56,141
NOTE.—Of the above services not put in there are									
Flush tanks									20
Order cancelled and cash refunded									2
									22

FREE SERVICES.

Ward	Flush	Poun-	Schoo-	Parks	Water
	Tanks	tains	lars		Dept.
First	30		1		
Second	30		1	1	
Third	15				1
Fourth	57	1			
Fifth	52				
Sixth	43	1		1	
Seventh	2				1
Eighth	1				
Ninth	11				
	211	2	2	1	1

Location—	Size, inches.	Length, feet.
Eighth St., East of Alameda St.....	12	82
Ninth St., Broadway to Figueroa St.....	12	2486
Ninth St., Figueroa to Burlington St.....	12	4565
Adams St., Hoover to Main St.....	12	5228
San Pedro St., Seventh to Agatha St.....	12	237
Vermont Ave., Adams to Jefferson St.....	12	2597
Total 12-inch laid to November 15th, 1907.....		15,193

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10 inch.....	16,558
12 inch.....	15,193
16 inch.....	8,055
18 inch.....	3,950
Total	274,984 feet = 52.08 miles.

SERVICES BY WARDS.

From November 15th, 1906, to November 15th, 1907.

Ward.	Size, Inches.								Total.	
	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	2	3	4	6		
First	413	31	6	2	..	..	..	..	452	
Second	388	27	5	..	6	..	1	..	427	
Third	30	62	43	1	7	3	1	5	152	
Fourth	269	131	20	..	10	1	..	..	432	
Fifth	824	106	32	..	1	..	..	1	964	
Sixth	824	62	11	2	9	1	2	..	910	
Seventh	52	7	3	1	2	..	..	4	70	
Eighth	22	4	4	..	4	..	..	..	34	
Ninth	453	24	3	1	1	..	..	..	482	
	3275	454	127	7	40	5	4	10	1	3923
Services sold but not put in.....									68	
										3991
Services in system November 15th, 1906.....										52,150
Sold during the year ending November 15th, 1907.....										3,991
Total services in system November 15th, 1907.....										56,141
NOTE—Of the above services not put in there are:										
Flush tanks										20
Order cancelled and cash refunded.....										2
										22

FREE SERVICES.

Ward.	Flush	Foun-	Schools.	Parks.	Water
	Tanks.	tains.			Dept.
First	30	..	1	..	..
Second	30	..	1	1	..
Third	15	..	..	..	1
Fourth	57	1	..	..	..
Fifth	52	..	..	..	..
Sixth	43	1	..	..	..
Seventh	2	..	..	..	1
Eighth	1	..	..	..	..
Ninth	11	..	..	..	..
	241	2	2	1	1

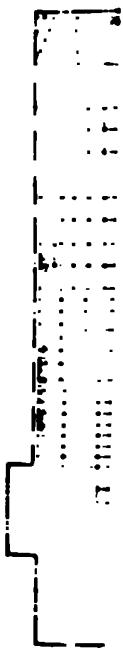
ceeded by any city of which we had record at that time, and amounted to more than 300 gallons per capita.

Following the metering of these places, a systematic plan was adopted of solidly metering the entire City. This was begun in the business section where excessive and extravagant use of water was very obvious and a constant source of irritation between the inspectors of the Department and the property owners. It was found that whereas this section of the City consumed between four and five million gallons of water per day, after meters were installed the consumption was reduced to much less than two million gallons per day, the difference representing an absolute waste.

It was found by proceeding in solid order to expand the meter district that the work was performed with far greater economy than by scattering the force and placing meters at random over a wide area. It was necessary, however, notwithstanding this saving of labor to still continue the practice of metering individual premises where complaints came in that the water was being wasted. Much assistance was given us in this matter by citizens who were thoughtful enough to be cognizant of the importance to the City of conserving our water supply and who called to our attention the derelictions of the careless and wasteful.

During the past year meters have been installed solidly block by block, until at the present time the whole shaded area shown on the accompanying map is metered.

There is quite a large section of the City lying mainly to the south, the soil of which is quite porous and sandy, but at the same time rich enough to be exceedingly productive when irrigated. This portion of the City to a large extent is inhabited by the thrifty working class who own their own homes and are prone not alone to beautify them but to attempt the raising of garden truck. This practice it is not the desire of the Department to discourage, for the reason that if proper care is taken, it requires less water to amply irrigate garden products than an equal area of lawn. But it was noticed that many of these people are careless and have an imperfect notion of the amount of water required to properly sustain vegetation.



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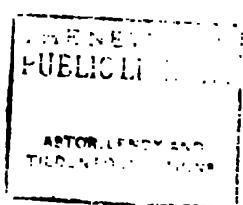
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1



As the soil is capable of absorbing water as fast as it will run from a faucet, the consumption of water on this class of property has been extravagantly high and wasteful. While this condition was far from general, still it became necessary to meter the district and check the waste. It is noticeable, however, that no one suffers from the practice of metering as people soon discovered that they could abundantly water their places without incurring unreasonable cost. So general has this knowledge become that applications for meters are made by many of these people in advance of the Department's ability to install them.

The following table shows the cost of meter installation, including the cost of labor and material.

5/8 inch	Placed in earth	\$1.85
	Placed in cement walks	1.95
	Making a mean of	\$1.90
3/4 inch	Placed in earth	\$2.90
	Placed in cement walks	3.10
	Making a mean of	\$3.05
1 inch	Placed in earth	\$2.40
	Placed in cement walks	2.50
	Making a mean of	\$2.45
1 1/2 inch	Placed in earth	\$3.45
	Placed in cement walks	4.00
	Making a mean of	\$3.75
2 inch	Placed in earth	\$4.90
	Placed in cement walks	5.75
	Making a mean of	\$5.35
3 inch	Placed in basement	\$16.75
	Placed in cement walk	21.00
	Making a mean of	\$18.85
4 inch	Placed in earth	\$22.50
	Placed in cement walk	27.00
	Making a mean of	\$24.75

NOTE: about 75 percent of the meters are placed in earth, so installed are enclosed in a wooden box having white wood frame & cast iron cover. Installation and maintenance costs of the above are paid by the Department.

Every meter installed is given a number corresponding to that of the factory and has what is called a maintenance card assigned to it. This card is duly filled out and properly filed when the meter is installed. It shows the result of the test, date of setting, registration and number of service on which the meter is placed. When any meter comes in for repairs, its registration and test (if it is still in condition to operate) is noted on the card before the repairs are made. The meter is then taken down and whatever repairs necessary made thereon and the cost of same noted, together with the cost of removing and of replacing the meter in service. In this manner the Department in course of time will have a very accurate knowledge of the merits of all the makes of meters in use, both as to accuracy and durability.

In the past year the Department has removed 2773 meters. Of this number 1487 were not operating, some because of mechanical imperfections due to wear or injury, but by far the larger number because of the fact that two of our reservoirs, being uncovered, generated much mossy algae and larvae which clogged in the meters in sufficient quantity to prevent their operation. Of the removals, 780 were due to replacement by larger meters when the services on which they were placed were required to be enlarged; 506 were removed on account of the use of water being discontinued through the services on which they were placed and many removals were made solely for testing purposes.

Every meter taken out on account of no further use or to be replaced by a larger one, when brought to the meter room, is treated just the same as if taken out for repairs and is tested, examined and repaired if necessary.

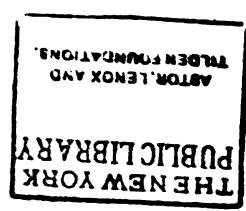
During the year, 2773 meters were removed at an aggregate cost as follows:

Total cost for removing and resetting.....	\$2495.00
Total cost of repairs for same.....	625.00
Total cost of labor in repairing.....	940.00

This makes an average cost per meter of \$1.46.



METER TESTING AND REPAIR SHOP



All meters purchased by the Department are tested at the factory, but to insure correctness we again test them by weighing the water that passes through them.

The cost of testing is as follows:

.5 ₆ inch meters.	.....	\$ .05 each
.3 ₄ inch meters.	.....	.05 each
1 inch meters.	.....	.05 each
1 ₁ / ₂ inch meters.	.....	.15 each
2 inch meters.	.....	.15 each
3 inch meters.	.....	.35 each
4 inch meters.	.....	.35 each

The meters when tested, record from 99 to 101 per cent., making a mean of 100 per cent, on flows at about their rated capacity, and at the extremely low rate of 10 cubic feet per hour at which they are required to show an accuracy of 100 per cent. This is an extremely severe test, and few makers will undertake to guarantee their meters for this result, but inasmuch as there are meters in the market that will attain this perfection, the Department exacts it from the factories.

Los Angeles has a local building ordinance, No. 1280, Sec. 123, making it compulsory for every three-story building to be supplied with a two-inch water service. Buildings more than three and not over five stories in height must have a two and one-half inch service, and when more than five stories, the building must be supplied by a three-inch service equipped with hose for fire fighting.

Prior to this ordinance nearly all these buildings had a service large enough to supply domestic water only. When these large services were put in, it was the understanding between the Department and the consumer that they were to be used for fire purposes only, and a flat rate to be charged as follows:

2 inch service	*1.00 per month
3 inch service	1.50 per month
4 inch service	2.00 per month
6 inch service	4.00 per month

It was afterwards discovered that these fire services through inadvertence or otherwise were used to supply domestic water,

the water meter. The cost of the meter is about \$1.00 per cubic foot of water measured. The cost of the piping is about \$1.00 per cubic foot of water measured. The cost of the piping is about \$1.00 per cubic foot of water measured.

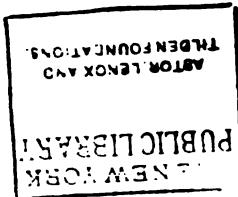
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METER DURABILITY TEST



This is based on reading and inspecting 23,000 metered services. All our meters are read monthly. This expense will be reduced materially as the number of meters is increased, less territory being required to be traversed by the readers than at present in the district not yet solidly metered.

All meters are billed monthly at the rate of seven cents per 100 cubic feet, or 748 gallons, to large and small consumers alike, with the minimum rate as follows:

5/8 inch and 3/4 inch meters.....	\$.75
1 inch meters.....	1.00
1 1/2 inch meters.....	1.50
2 inch meters.....	2.00
3 inch meters.....	3.00
4 inch meters.....	4.00

When a meter fails to register, the bill is computed at an average rate by taking the mean of the bills for the three preceding months. If not discovered out of order until after bill is rendered, a corrected bill follows.

Respectfully submitted,

GEORGE READ,

Chief Meter Inspector.

AUDITOR'S REPORT

For the Year Ending November 30, 1907

Los Angeles, Cal., Dec. 16, 1907.

To the Honorable the Board of Water Commissioners,
Of the City of Los Angeles, Cal.

Gentlemen:—I have the pleasure of herewith submitting the sixth annual report of the Financial operations of the Water Department.

The report for the year just closed, ending November 30th, 1907, shows a gain of \$65,550.42 in collections, over the preceding year.

The statements following will show more fully the sources of revenue and the distribution of expenditures.

I wish to submit for your consideration at this time, a suggestion in regard to the time and manner of making our collections. I find that the Los Angeles Water Department is one of a very few that make collections oftener than quarterly or semi-annually, and many cities collect annually in advance. Cleveland collects semi-annually; Milwaukee semi-annually for flat rates and quarterly for meter rates; Rochester, New York, semi-annually and quarterly; and Detroit and Kansas City quarterly. Many others might be mentioned, but these are sufficient.

Detroit and Milwaukee have been very successful in the management of their waterworks, and regulations similar to theirs should work to great advantage.

I would suggest that the bills be payable quarterly at the office, the flat rate bills to be paid during the first 20 days of the quarter in advance, and the meter bills within 20 days after the end of the quarter. If not so paid in both cases interest should be charged, and a notice of the delin-

quency be mailed or delivered to the property; the 10 per cent. will cover all the expense of such notice. If bills are not paid within the next 30 days, the water to be shut off and a penalty of \$1.00 in addition be charged to cover the expense of shutting it and turning on.

A very considerable saving could be made if you should deem it wise to make the change, as our force of Billmakers and Collectors is constantly increasing. I also believe there would be less friction in having the payments made at the office, as it would do away with any misunderstanding, (which is now frequent), of when the bills should be paid, and the responsibility of the water being shut off if not paid for. There are many arguments in support, and some against making the change, but in the whole I believe it would be advantageous.

Another matter of importance that might be brought up at this time is in regard to water furnished to the city, for which nothing is paid and no charge is made. The Water Department should get a credit for this water. Roughly estimated, the City is now using about \$150,000.00 worth of free water a year, and the demand is constantly increasing. The City should be charged for this, and the water account should get the credit. The basis of making the charges can be taken up later.

Thanking your Honorable Body for support and courtesies extended, I remain,

Yours truly,

L. M. ANDERSON, Auditor

BUDGETARY REPORT

RECEIVED FOR THE YEAR ENDING NOVEMBER 30, 1917

Balances on hand Report Value, less Fund	\$ 16,329.22
Balances on hand Report less Fund 7,000	\$ 9,329.22
	+ 11,250.00

COLLECTIONS.

Water Tax	\$ 438,736.50
Interest on water tax - 1917	1,741.47
Interest on water tax	10,414.72
Interest	1,54.40
Minerals	1,099.00
Surplus - water tax balance	6,219.54
Interest on water tax - 1917	1,91.00
	- \$ 452,660.75
Interest on advances	4.40
Interest on advances for supplies	2.50
Interest on V. A. Advance Advances	25.00
	- 31.90
	- \$ 452,660.75
	81,169,220.93

DISBURSEMENTS.Construction and Betterments.

Water Tax	\$ 385,120.62
Water Tax - interest	17,942.28
Minerals	101,378.78
Water Tax - Interest	60,056.53
Water Tax - Interest	29,756.98
Interest - Interest	36,571.97
High Water Pumping Plant	25,038.42
Crescent Springs Order	1,387.82
Interest - Water	4,740.13
Interest - Interest - Interest	15,129.17
Interest - Interest	10,487.40
Interest	1,943.75
Interest - Interest	147.47
Interest - Interest	1,122.72
Interest - Interest	1,077.41
Interest - Interest	1,077.41
	- 740,120.98

Board of Water Commissioners

31

Operating and Maintenance.

Brought forward	\$ 740,123.38
General operating	\$152,840.04
Buena Vista Pumping Plant	23,772.71
Garvanza Pumping Plant	2,019.92
Edendale Pumping Plant	3,376.38
Slauson Pumping Plant	5,178.99
Pollock Pumping Plant	202.40
Burbank Pumping Plant	854.66
Figueroa Pumping Plant	880.82
Head Works Pumping Plant.....	1,635.47
San Fernando Case (legal).....	2,270.20
	193,031.59

Sundries.

Furniture and fixtures	\$ 9,841.89
Deposits returned	5,628.50
Transferred to interest and sinking fund.....	149,085.63
Advanced to L. A. Aqueduct.....	54,067.00
Sundry deposits returned	271.00
	218,894.02
	\$1,152,048.99

RECEIPTS BY MONTHS.**December, 1906.**

Water	\$79,056.62
Permits	1,409.30
Services	2,809.00
Rent	133.00
Meters	280.00
Deposits	2,409.00
Sundries	1,285.68
	87,382.60

January, 1907.

Water	\$76,522.40
Permits	1,735.60
Services	3,200.00
Rent	125.00
Meters	262.50
Deposits	650.00
Sundries	1,303.87
L. A. Aqueduct advances returned.....	8,800.00
	92,599.37

*Sixth Annual Report***February, 1907.**

Water	\$75,001.55
Permits	1,195.45
Services	4,365.00
Rent	403.75
Meters	357.00
Deposits	120.00
Sundries	208.25
	—————
	\$91,651.00

March, 1907.

Water	\$70,904.86
Permits	1,236.15
Services	3,311.00
Rent	125.00
Meters	790.00
Deposits	380.00
Sundries	1,817.66
Cancelled demands	2.55
	—————
	\$78,567.22

April, 1907.

Water	\$71,514.30
Permits	1,130.47
Services	3,681.00
Rent	500.00
Meters	646.45
Deposits	740.00
Sundries	2,062.10
Cancelled demand	2.35
	—————
	\$80,276.67

May, 1907.

Water	\$74,293.65
Permits	3,239.92
Services	3,397.00
Rent	200.00
Meters	1,046.50
Deposits	789.00
Sundries	1,579.81
	—————
	\$84,545.88

June, 1907.

Water	\$76,764.80
Permits	1,299.55
Services	3,433.00
Rent	536.25
Meters	955.50
Deposits	64.00
Sundries	1,102.02
	—————
	\$84,155.12

July, 1907.

Water	\$82,112.85
Permits	2,141.21
Services	2,694.48
Rent	255.00
Meters	924.50
Deposits	919.00
Sundries	1,807.24
	—————
	\$90,854.28

August, 1907.

Water	\$85,454.15
Permits	1,231.97
Services	3,378.39
Rent	250.00
Meters	1,252.50
Deposits	360.00
Sundries	1,607.71
Discount on demand for supplies.....	23.55
L. A. Aqueduct advances returned.....	16,500.00
	—————
	\$110,058.27

September, 1907.

Water	\$83,538.10
Permits	2,317.40
Services	3,219.00
Rent	125.00
Meters	1,148.10
Deposits	1,248.00
Sundries	1,365.83
	—————
	\$92,961.43

*sixth Annual Report***October, 1907.**

Wages	\$44,272.51
Materials	1,921.10
Taxes	1,257.77
Rent	130.00
Delivery	1,081.25
Insurance	122.00
Telephone	369.77
	<hr/>
	\$48,653.11

November, 1907.

Wages	\$76,660.24
Materials	1,521.77
Taxes	1,254.25
Rent	130.00
Delivery	1,081.00
Insurance	369.62
	<hr/>
	\$82,573.06

DISTRIBUTION BY MONTH.**December, 1906.**

	Wages.	Material.	Total.
Manufacture	\$15,731.59	447,345.03	463,076.52
Marketing	1,772.93	1,171.98	1,944.91
General and Office		11.72	11.72
Delivery		100.00	100.00
Rent		1,367.00	1,367.00
	<hr/>	<hr/>	<hr/>
	\$17,503.52	474,614.01	492,117.53

January, 1907.

Wages	\$15,731.59	7,145.00
Materials	1,772.93	1,171.98
Taxes	1,187.77	11.72
Rent		130.00
Delivery		1,081.00
Insurance		369.62
	<hr/>	<hr/>
	\$17,503.52	8,392.60

February. 1907.

	Labor.	Material.	Total.
Construction	\$14,811.16	\$27,569.45	\$42,380.61
Operating	11,541.40	2,528.63	14,070.03
Furniture and Fixtures.....		2,569.00	2,569.00
Deposits returned		120.00	120.00
	<hr/>	<hr/>	<hr/>
	\$26,352.56	\$32,787.08	\$59,139.64

March, 1907.

	Labor.	Material.	Total.
Construction	\$15,325.88	\$38,226.28	\$53,552.16
Operating	11,576.69	3,439.81	15,016.50
Furniture and Fixtures.....		1,415.76	1,415.76
Deposits returned		228.00	228.00
Sundries		271.00	271.00
	<hr/>	<hr/>	<hr/>
	\$26,902.57	\$43,580.85	\$70,483.42

April, 1907.

	Labor.	Material.	Total.
Construction	\$17,402.36	\$26,173.94	\$43,576.30
Operating	11,759.30	3,149.67	14,908.97
Furniture and Fixtures.....		2,192.24	2,192.24
Deposits returned		904.00	904.00
	<hr/>	<hr/>	<hr/>
	\$29,161.66	\$32,419.85	\$61,581.51

May, 1907.

	Labor.	Material.	Total.
Construction	\$17,886.50	\$76,368.27	\$94,254.77
Operating	11,670.90	3,841.86	15,512.76
Furniture and Fixtures.....		561.18	561.18
Deposits returned		280.00	280.00
	<hr/>	<hr/>	<hr/>
	\$29,557.40	\$81,051.31	\$110,608.71

June, 1907.

	Labor.	Material.	Total.
Construction	\$19,687.43	\$71,422.70	\$91,110.13
Operating	11,604.50	4,114.07	15,718.57
Furniture and Fixtures.....		2,404.98	2,404.98
Deposits returned		636.50	636.50
	<hr/>	<hr/>	<hr/>
	\$31,291.93	\$78,578.25	\$109,870.18

July, 1907.

	Labor.	Material.	Total.
Construction	\$20,590.08	\$16,727.78	\$37,317.86
Operating	12,255.30	3,447.91	15,703.21
Furniture and Fixtures.....		83.90	83.90
Deposits returned		1,111.00	1,111.00
	\$32,845.38	\$21,370.59	\$54,215.97

August, 1907.

	Labor.	Material.	Total.
Construction	\$22,256.73	\$83,441.37	\$105,698.10
Operating	13,059.65	5,250.04	18,309.69
Furniture and Fixtures.....		214.32	214.32
Deposits returned		224.00	224.00
Interest and sinking fund.....		149,085.63	149,085.63
	\$35,316.38	\$238,215.36	\$273,531.74

September, 1907.

	Labor.	Material.	Total.
Construction	\$19,167.79	\$50,563.89	\$69,731.68
Operating	12,483.50	6,538.49	19,021.99
Furniture and Fixtures.....		99.65	99.65
Deposits returned		380.00	380.00
	\$31,651.29	\$57,582.03	\$89,233.32

October, 1907.

	Labor.	Material.	Total.
Construction	\$19,592.38	\$37,537.81	\$57,130.19
Operating	13,051.83	3,811.62	16,863.45
Furniture and Fixtures.....		158.70	158.70
Deposits returned		960.00	960.00
	\$32,644.21	\$42,368.13	\$75,012.34

November, 1907.

	Labor.	Material.	Total.
Construction	\$18,699.93	\$24,199.29	\$42,899.22
Operating	12,783.50	4,157.50	16,941.00
Furniture and Fixtures.....		49.20	49.20
Deposits returned		324.00	324.00
Vouchers		35,000.00	35,000.00
	\$31,483.43	\$63,729.99	\$95,213.42

TOTAL RECEIPTS AND DISBURSEMENTS.**Receipts.**

Febru'y 4 to Nov. 30, 1902.....	\$ 456,317.83
Year ending Nov. 30, 1903.....	614,264.92
Year ending Nov. 30, 1904.....	772,978.32
Year ending Nov. 30, 1905.....	\$ 906,233.01
Year ending Nov. 30, 1905, Bonds..	1,671,431.33
	————— 2,577,664.34
Year ending Nov. 30, 1906.....	983,757.76
Year ending Nov. 30, 1907.....	1,058,989.21
	————— \$6,463,972.38

Disbursements.

Febru'y 4 to Nov. 30, 1902.....	\$ 314,163.56
Year ending Nov. 30, 1903.....	733,493.13
Year ending Nov. 30, 1904.....	777,813.74
Year ending Nov. 30, 1905.....	1,066,402.54
Year ending Nov. 30, 1906.....	1,821,984.65
Year ending Nov. 30, 1907.....	\$1,152,048.99
Year ending Nov. 30, 1907, transfer to L. A. Aqueduct.....	580,893.83
	————— 1,732,942.82
	————— 6,446,800.44
Balance in Water Revenue Fund.....	\$ 17,171.94

BONDS.

	Year Issued.	Rate.	Original Amount.	Outstanding.
Water Works Improvement....	1895	4 1/2%	\$ 30,000.00	\$ 21,000.00
Water Works	1901	3 3/4%	2,000,000.00	1,700,000.00
Water Works	1904	3 3/4%	337,500.00	300,000.00
Water Works (Reservoir)....	1904	3 3/4%	150,000.00	138,750.00
Water Works (L. A. Aqueduct)	1905	4 %	1,500,000.00	1,425,000.00
			\$4,017,500.00	\$3,584,750.00

CONDITION OF FUNDS DEC. 1, 1907.

Water Revenue Fund	\$17,171.94
Interest and Sinking Fund Bonds 1895.....	\$ 1,695.00
Interest and Sinking Fund Bonds 1901.....	31,875.00
Interest and Sinking Fund Bonds 1904.....	23,750.00
Interest and Sinking Fund Res., 1904.....	8,853.13
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Total balances with City Treasurer.....	\$83,445.07

LAND INSIDE CITY.

	Assessed Value.	Appraised Value.
East Side Springs, Mullaly's Addn.,.....	\$ 1,000.00	\$ 2,000.00
Hazard Reservoir, Lots 1 & 2, Blk. 4, Florence Tr.,	180.00	700.00
Hazard Reservoir, 2 acres	600.00	2,000.00
Victor Hts. Tr., Lots 133 to 144 incl.,.....	3,840.00	10,000.00
Beaudry Res. Site	3,500.00	7,000.00
Angeleno Res. Site, 1 acre,	1,000.00	2,000.00
Lot 31 $\frac{1}{2}$, Hunter's Highland View Tr., 8 acres,....	2,000.00	4,000.00
Lots 21, 22, 23, 24, Blk. 28, De Soto Hts. Tr.,	600.00	1,500.00
Lot 15, Blk. 3, Augusta Hts. Tr.,	80.00	200.00
Cor. Alameda & Marchessault Sts. (Old Office),....	5,490.00	15,000.00
2.65 acres bet. Buena Vista Tr. & Elysian Park,..	1,060.00	2,500.00
Belleview Reservoir, 8 acres	4,000.00	10,000.00
Lots 6 to 12 incl., Blk. "G," Lincolonian Hts. Tr.,	1,400.00	4,200.00
Part of Lot 8, Blk. 33, H. S.,	750.00	2,000.00
Highland Reservoir, 10.5 acres,	10,500.00	15,000.00
Yards, bounded by Rose, Alameda, 2d & Stephenson	\$8,000.00	50,000.00
Reservoir No. 1, 24 acres,	10,000.00	20,000.00
Solano Reservoir Site	1,100.00	2,200.00
Stevens Lake, Ass. Site, Same date balances,.....	7,600.00	25,000.00
Stephenson Ave., 2nd Street, N. of 1st, Simpson Ave.,	9,000.00	20,000.00
Figueroa Ave., bet. 18th & 19th Streets, 2, 16, 17, McCarthy		
F. N. 16, 17, 18, 19th Streets, 2, 16, 17, McCarthy	1,680.00	5,400.00
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	\$73,380.00	\$290,700.00

LAND IN COUNTY.

	Appraised Value.
Portions of Lots 18, 19 & 21, Blk. 3, Ivanhoe.....	\$ 100.00
Ivanhoe Res. Site, bd. by Clyde, Rowena, Maxwell & Et-	
trick St.	5,000.00
Lot 9, Blk. 1, & Lot 50, Blk. 3, Ivanhoe.....	500.00
Portion of Lot 21, Blk. 31, Ivanhoe.....	200.00
Land bd. by Lick Tr. & Griffith Land & River, 43.62 acres...	4,362.00
Lot 7, Blk. 81, Providencia & Scott Tr., 22.60 acres.....	2,260.00
Crystal Springs Land, 4.09 acres	800.00
In Rio, San Rafael, 32 acres	3,200.00
Darby Reservoir Site, 9.052 acres	1,800.00
In Ro. San Rafael, bd. south by Ro. Los Feliz, 23.15 acres....	2,315.00
Pomeroy & Hooker Lands, 314.82 acres.....	31,482.00
Lands in Rancho Providencia, 285.00 acres.....	28,500.00
Lands in Rancho Providencia (West Side Purchase), 358 acres	35,800.00
High Service Reservoir, Garvanza, about 1.00 acres.....	1,000.00
Pollock Place, in Ro. Los Feliz, 9.50 acres.....	5,500.00
Reservoir No. 7, 110.00 acres	50,000.00
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	\$172,819.00







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